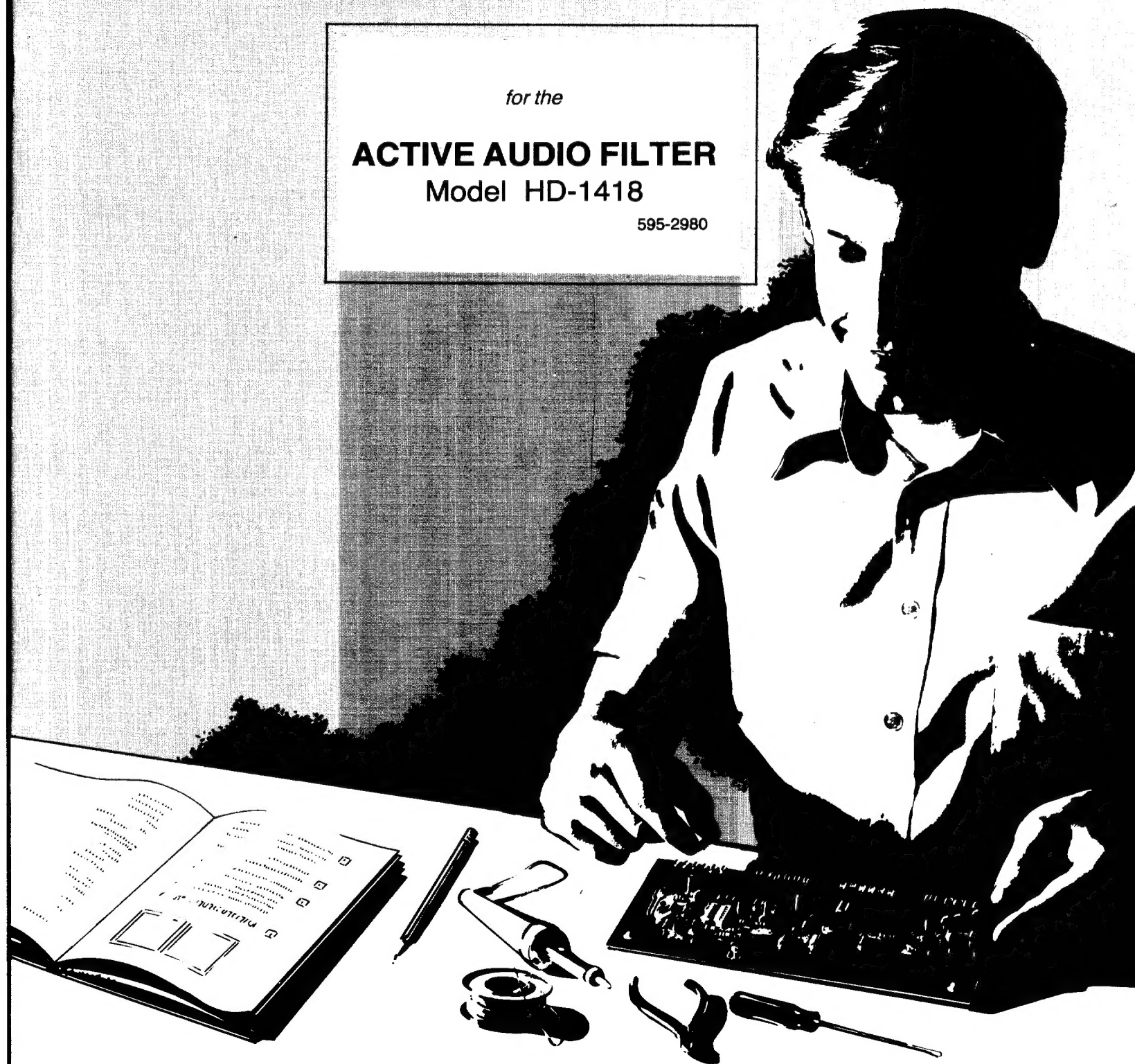


HEATHKIT[®] MANUAL

for the

ACTIVE AUDIO FILTER
Model HD-1418

595-2980



HEATH COMPANY • BENTON HARBOR, MICHIGAN

Heathkit® Manual

for the

ACTIVE AUDIO FILTER

Model HD-1418

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HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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The Heathkit Model HD-1418 Active Audio Filter has five-pole (section) high-pass and low-pass filters plus a two-pole notch/peak filter. You can move these filters through a 300 to 2500 Hz audio frequency band to help you select or reject certain frequency components of signals you tune in with your shortwave communication equipment. This Filter can help eliminate unwanted signals, such as sideband interference from the partial overlapping of SSB signals or heterodyning, as long as the unwanted signal has a slightly different frequency than the desired signal.

Pushbuttons allow you to easily configure the Filter to meet the common shortwave communication needs, such as RTTY, CW, and SSB applications.

This Manual provides you with assembly and operation instructions, plus a circuit description, troubleshooting chart, and other post-construction information.

PARTS LIST

Unpack your kit and check each part against the following list. Do not remove components that are supplied on a tape from the tape until you use them in a step. Return any part that is packed in an individual envelope, with the part number on it, back to the envelope after you identify it until that part is called for in a step. Do not throw away any packing material until all of the parts are accounted for.

To order a replacement part, always include the PART NUMBER. Use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of this Manual. For prices, refer to the separate "Heath Parts Price List."

TAPED COMPONENTS

Refer directly to the enclosed "Taped Component Chart." Follow the instructions at the top of that chart to check the following components.

HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
RESISTORS			
NOTE: The following resistors are rated at 1/4-watt and have a tolerance of 5% unless otherwise listed. A 5% tolerance is indicated by a fourth color band of gold. 1% is indicated by a brown fifth color band.			
6-279-12	1	2.7 Ω (red-viol-gold)	R74
6-100-12	1	10 Ω (brn-blk-blk)	R81
6-470-12	1	47 Ω (yel-viol-blk)	R97
6-680-12	1	68 Ω (blu-gry-blk)	R2
6-471-12	1	470 Ω (yel-viol-brn)	R96
6-621-12	1	620 Ω (blu-red-brn)	R11
6-681-12	1	680 Ω (blu-gry-brn)	R1
6-821-12	1	820 Ω (gry-red-brn)	R12
6-102-12	1	1000 Ω (brn-blk-red)	R75
6-152-12	2	1500 Ω (brn-grn-red)	R4, R82
6-222-12	2	2200 Ω (red-red-red)	R71, R77
6-332-12	5	3300 Ω (org-org-red)	R9, R17, R19, R103, R106
6-392-12	3	3900 Ω (org-wht-red)	R94, R99, R102
6-562-12	2	5600 Ω (grn-blu-red)	R3, R8
6-6651-12	1	6650 Ω , 1% (blu-blu-grn-brn)	R24

HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
Resistors (Cont'd)			
6-103-12*	31	10 k Ω (brn-blk-org)	R6, R13, R14, R15, R16, R23, R25, R28, R29, R31, R33, R36, R37, R39, R41, R48, R49, R51, R53, R55, R58, R59, R62, R78, R79, R87, R88, R93, R98, R101, R105
6-1912-12	1	19.1 k Ω , 1% (brn-wht-brn-red)	R26
6-273-12	3	27 k Ω (red-viol-org)	R68, R69, R72
6-3482-12	5	34.8 k Ω , 1% (org-yel-gry-red)	R46, R47, R54, R56, R64
6-3652-12	2	36.5 k Ω , 1% (org-blu-grn-red)	R32, R52
6-393-12	1	39 k Ω (org-wht-org)	R67

* These resistors are packed in a separate envelope with the part number on it.

HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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Resistors (Cont'd)

6-4422-12	6	44.2 kΩ, 1% (yei-yel-red-red)	R21, R22, R42, R45, R63, R65
6-5362-12	2	53.6 kΩ, 1% (grn-org-blu-red)	R38, R57
6-563-12	1	56 kΩ (grn-blu-org)	R104
6-5622-12	4	56.2 kΩ, 1% (grn-blu-red-red)	R34, R35, R43, R66
6-823-12	2	82 kΩ (gry-red-org)	R85, R86
6-104-12	2	100 kΩ (brn-blk-yel)	R7, R27
6-2613-12	2	261 kΩ, 1% (red-blu-brn-org)	R44, R61
6-274-12	2	270 kΩ (red-viol-yel)	R83, R84
6-394-12	1	390 kΩ (org-wht-yel)	R18
6-105-12	1	1 MΩ (brn-blk-grn)	R95

CAPACITORS

21-784	6	.001 μF (102) glass ceramic	C8, C45, C47, C48, C51, C53
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HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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Capacitors (Cont'd)

21-761	6	.01 μF (103) glass ceramic	C1, C2, C3, C4, C34, C35
21-762	7	.1 μF (104) glass ceramic	C5, C9, C33, C37, C39, C61, C62

DIODES

57-65	4	1N4002	D1, D2, D3, D4
56-56	2	1N4149	D6, D7
56-608	1	1N4739A	D5

NON-TAPED PARTS

The following parts are not taped on strips.
The key numbers correspond to the numbers on the "Parts Pictorial" (Illustration Booklet, Page 1).

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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CAPACITORS**Ceramic**

A1	21-738	1	68 pF	C56
A2	21-75	1	100 pF (100K)	C31
A2	21-184	1	750 pF	C36

Mylar

A3	27-129	1	.047 μF	C58
A3	27-85	1	.22 μF	C32

Polystyrene

A4	29-5	14	1000 pF	C13, C16, C17, C18, C19, C21, C22, C23, C25, C26, C27, C28, C29, C55
A4	29-7	1	1500 pF	C15

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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Electrolytic

A5	25-900	5	1 μF	C11, C24, C46, C49, C52
A5	25-880	6	10 μF	C12, C14, C38, C43, C54, C57
A5	25-883	3	47 μF	C42, C44, C59
A5	25-891	1	470 μF	C41
A5	25-951	2	1000 μF	C6, C7

CONTROLS

B1	10-1196	2	10 kΩ	R91, R92
B1	10-1197	1	20 kΩ	R73
B2	12-185	1	Dual 10 kΩ control	R76/R89

SWITCHES

C1	64-919	1	Pushbutton	S1
C2	64-920	1	4-section pushbutton	S2/3/4/5

Heathkit®

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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TRANSISTORS--INTEGRATED CIRCUITS (IC's)

NOTE: Transistors and integrated circuits may be marked for identification in any of the following four ways:

1. Part number.
2. Type number. (On integrated circuits this refers only to the numbers; the letters may be different or missing.)
3. Part number and type number.
4. Part number with a type number other than the one listed.

D1	417-801	1	MPSA20 transistor	Q1
D2	442-21	14	MC1458 IC	U2, U3, U4, U5, U6, U7, U8, U9, U10, U11, U12, U15, U16, U17
D2	442-75	1	LM311P IC	U1
D2	442-616	1	LM2901N IC	U18
D2	442-748	1	ULN2280B IC	U13
D2	442-744	3	CD4066BCN IC	U20, U21, U22
D2	443-604	1	CD4007AE or MC14007UB IC	U14
D2	443-701	1	MC14049CP or CD4049CN IC	U19

HARDWARE

NOTE: Hardware packets are marked to show the size of the hardware they contain (HDW #4, or HDW #6 & #8, etc.). You may have to open more than one packet to locate all of the hardware of any one size (#6, for example).

#4 Hardware

E1	250-366	8	4-40 × 3/16" screw
E2	250-1184	2	#4 × 1/4" self-tapping screw
E3	254-9	4	#4 lockwasher
E4	255-798	4	4-40 × 1/4" hex spacer

#6 Hardware

F1	250-33	4	6-32 × 1/8" setcrew
F2	250-1307	4	#6 × 1/4" sheet metal screw
F3	250-1280	6	6-32 × 3/8" screw
F4	252-3	6	6-32 nut
F5	254-1	6	#6 lockwasher

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
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Other Hardware

G1	252-194	1	Decorative control nut
G2	253-15	3	Fiber control flat washer
G3	253-731	2	Shoulder washer
G4	259-34	4	Control solder lug
G5	811-1	4	Metric control nut

CONNECTORS--SOCKETS

H1	432-866	4	Spring connector	
H2	432-1030	2	2-pin socket shell	
H3	434-42	3	Phono socket	J3, J4, J5
H4	434-230	15	8-pin IC socket	
H4	434-298	5	14-pin IC socket	
H4	434-299	1	16-pin IC socket	
H5	436-45	1	Power jack	J2
H6	436-57	1	Phone jack	J1
H7	438-54	1	Power plug	

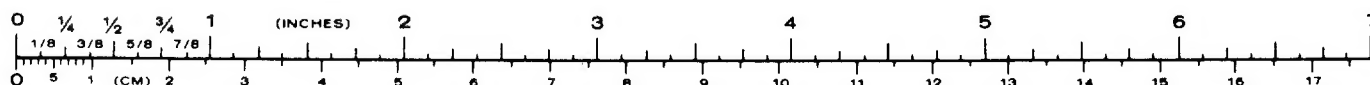
MISCELLANEOUS

J1	3-22-2	1	1.2Ω, 2-watt, 10% (brn-red-gold-silv) resistor	R5
J2	75-743	2	Insulator paper	
	85-2834-1	1	Circuit board	
J3	90-1299-1	1	Cabinet top	
J4	200-1431-1	1	Chassis	
J5	261-29	4	Foot	
	340-8	1'	Bare wire	
	344-125	2'	Black wire	
	344-128	2'	Orange wire	
	344-170	4'	Violet wire	
J6	412-633	2	Light-emitting diode (LED)	D8, D9
J7	455-44	4	Bearing	
J8	462-1138	5	Pushbutton knob	
J9	462-1157	4	Round knob	
J10	475-17	4	Ferrite core	
J11		1	Blue and white label*	
	597-260	1	Parts Order Form*	

Assembly Manual (See Page 1 for the part number.)

Solder

*These items may be packed inside the Manual.



INITIAL TESTS

IMPEDANCE CHECKS

You will need a volt-ohmmeter to perform the following tests. If you do not have one, move ahead to the "Operational Checks." Refer to Pictorial 2-1 (Illustration Booklet, Page 10) for test points mentioned in the steps.

If you get the correct results in the following tests, proceed to the "Operational Checks." If you do not get the correct results, disconnect the power. Then troubleshoot your Filter using the information from the "In Case Of Difficulty" section of this Manual and the schematic diagram.

- () Set your ohmmeter to the $R \times 100$ scale and make these three measurements at the power jack (J2). Each measurement must be at least 500Ω , although your meter may give a much higher reading.
 1. Lug 1 to ground.
 2. Lug 2 to ground.
 3. Lug 1 to lug 2.
- () Connect your power source to the Filter and push the **Power** button. The power LED (D8) should light, and you should be able to measure at least 7.5 VDC at the emitter (E) of regulator transistor Q1.

OPERATIONAL CHECKS

Perform these checks to verify that the various functions of the Filter are all working properly. If you find that a function is not working, turn your Filter off and troubleshoot the difficulty before you proceed any further.

- () Connect your receiver's speaker output to the **Input** connector on the back of the Filter. Set the **Low** control fully counterclockwise, and the **High** control fully clockwise. Leave the four filter operation pushbuttons in the out position. Supply power to the **9-18 VDC Supply** power jack, but do not turn the Filter on.
- () Connect your speaker to the Filter's **Output** jack, or connect headphones to the front panel **Phones** jack.
- () Turn your receiver on and tune to a station. With the Filter off, you should hear your receiver's output at normal volume.
- () Turn the Filter on, set the **SSB** and **SSB & Peak** pushbuttons to their in position, and turn the **Gain** control fully clockwise. The Filter's gain is about unity, so the speaker volume should be about the same as before.

Checking Peak Operation

- () Leave the Filter connected as it was in the previous step, and set the pushbuttons so that only the **SSB & Peak** button is in.
- () Tune to a station that is transmitting a continuous carrier wave. (If your receiver has a calibrator, you could turn it on and use its signal.)
- () Adjust the **Notch/Peak** control until you obtain maximum volume of the tone. If moving the control to other positions gives less volume, then the peak filter is operating.

Checking Notch Operation

- () Begin with all controls set as they were in the previous step. Tune to a station that is transmitting a continuous carrier wave. (If your receiver has a calibrator, you could turn it on and use its signal.) Then release the **SSB & Peak** and press the **SSB & Notch** button. Turn the **Notch/Peak** control slowly in each direction. When the notch is directly on the tone's frequency, you should be able to hear a noticeable decrease in the volume of the tone.

Checking Low Filter

- () Reset the Filter pushbuttons, so that **SSB** is in and the others are out, and set the **Low** control fully counterclockwise. Slowly turn the **Low** control clockwise. You should hear the change in sound as the lower frequency sounds are attenuated.

Checking High Filter

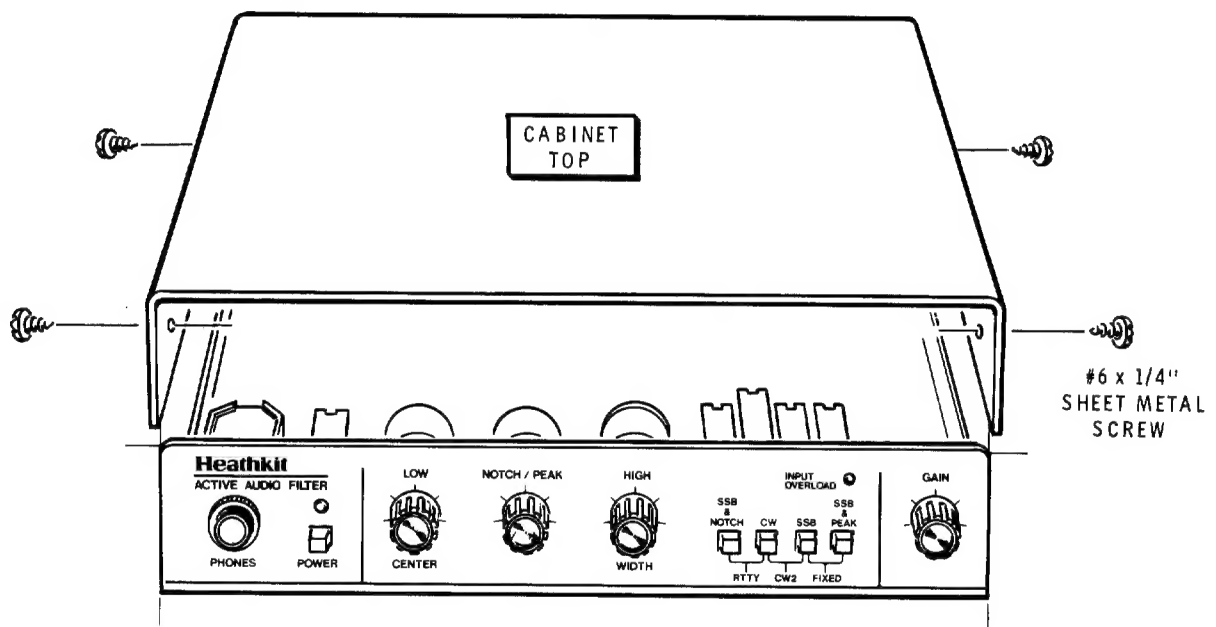
- () Return the **Low** control to its counterclockwise end and begin with the **High** control fully clockwise. Slowly turn the **High** control counterclockwise. You should hear the change as the higher frequency sounds are attenuated.

This completes the Initial Tests. Proceed to "Final Assembly."

FINAL ASSEMBLY

- () Position the cabinet top onto the chassis as shown in Pictorial 3-1. Then use four #6 × 1/4" sheet metal screws to secure the cabinet top to the chassis.

This completes the "Final Assembly."



PICTORIAL 3-1

OPERATION

In an effort to make this Manual as useful as possible, we will address the Filter's operation from two points of view. First we will address controls and connection points separately, and tell what each does. This section is useful when you are first becoming familiar with the Filter, and can be a valuable reference section later if you have questions.

Next is the "Applications" section, where we will show and discuss frequency response curves you will commonly use, and tell what buttons you push to obtain them. The "Applications" section also contains information about how you might typically install a Filter in your system.

BACK PANEL CONNECTIONS

Refer to Pictorial 4-1 (Illustration Booklet, Page 11) for a drawing of the Filter's back panel. Each connection is labeled and discussed in that Pictorial. For further information about how you might choose to connect the Filter into your specific system, you may wish to refer to Page 39.

FRONT PANEL, SINGULAR CONTROLS

Refer to Pictorial 4-2 for an illustration of the Filter's front panel. Some of the Filter's controls are "interactive." That is, changing the setting of one of them directly affects the other(s). The controls and outputs discussed in the following paragraphs are "singular" (NOT interactive).

Phones

This provides a front-panel processed and amplified audio output that you may use for headphones or speaker (4 ohms or higher). If you Plug into the **Phones** jack, the **Output** at the rear panel will automatically be disconnected.

Power

The **Power** switch turns the Filter on and off. While the power is on, the LED above the **Power** switch will glow and the processed amplified signal will be output to either the **Phones** or **Output** jacks. The processed (but not amplified) signal will also be at **Tape Out** jack. With the **Power** switch off, the input to the Filter will not be processed but will go straight to **Tape Out** and either **Phones** or **Output**.

Gain

While the Filter is on, this control determines the gain of the Filter's amplifier section (the output to either **Phones** or **Output**).

Input Overload

This LED lights if the input signal coming to the Filter from your transceiver or receiver is more than 3 volts peak-to-peak and may cause distortion in the Filter's circuitry.

FRONT PANEL, INTERACTIVE CONTROLS

Continue to refer to Pictorial 4-2 for the following.

NOTE: In this section of the Manual, colored panel labels are shown in *italic* letters, and the white labels are shown in **bold** letters.

Some controls directly affect each other. The position of the four pushbuttons determine what the three control knobs actually control. Look at the front panel of your Filter and notice that some of the knob and button labels are printed in white while others are in color; this coding is to illustrate how they interact. If the **push-button** positions correspond to a colored label, the **knob** functions also correspond to their colored labels. (For instance, pressing **SSB & Notch** and **CW** puts the Filter in *RTTY* operation. This causes the controls to work as *CENTER*, and *WIDTH* with the **Notch/Peak** control inoperative.)

Low-Center

As a **Low** control, this knob moves the low cutoff end of the bandpass filter up or down, between 300 and 2500 Hz. When you select it as a *CENTER* control, the knob moves the center of the passband up and down from 300 Hz to 2500 Hz, and is coupled with the *WIDTH* control.

High-Width

As a **High** control, this knob moves the high cutoff end of the bandpass filter up or down, between 300 and 2500 Hz. When you select it as a *WIDTH* control, the knob widens or narrows the band around the frequency selected by the *CENTER* control.

Notch/Peak

This control has a special limitation that is different from the others. It is activated only by the pushbuttons that have **Notch** or **Peak** as part of their label, but it will be deactivated if you push the **SSB** pushbutton. This control can move the notch or peak anywhere within the bandpass, including either edge to make the roll-off steeper.

Pushbuttons

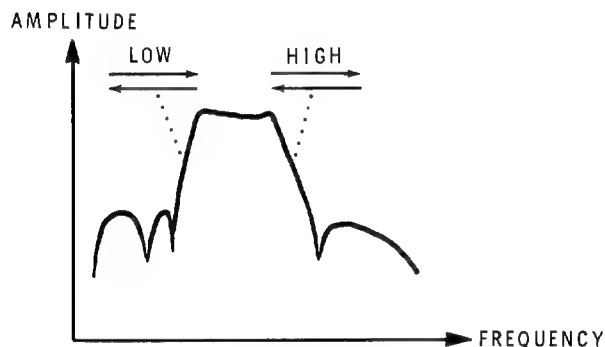
There are seven common modes of operation you can select by pressing either one or two pushbuttons in the patterns shown on the front panel. These combinations are listed and discussed under the following "Applications" section.

APPLICATIONS

Curves and Applications

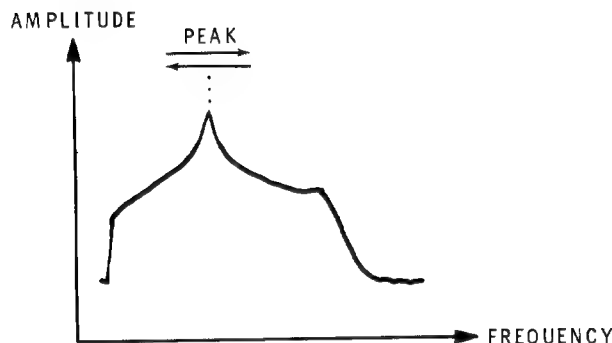
Refer to the following Pictorials to see the approximate filter bandpass characteristics, and the control actions, for the seven different combinations of pushbutton positions. While the name for each mode describes the typical use for that mode, you may also think of other times when it might suit a special need.

Pictorial 4-3 shows the SSB mode (pushbutton S4 pressed) Filter characteristics, including the effect of the **High** and **Low** controls. (In this and the following paragraphs, only the controls that will be active are mentioned.)



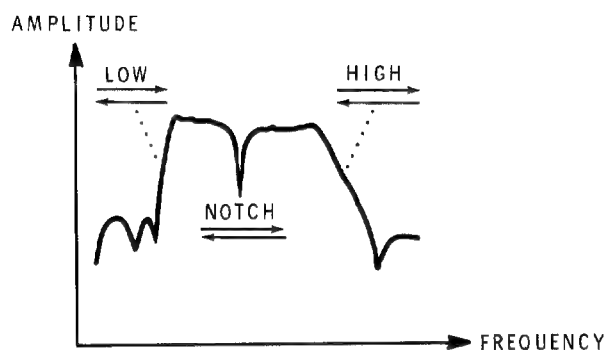
PICTORIAL 4-3

Pictorial 4-4 shows the SSB & PEAK mode (pushbutton S5 pressed) Filter characteristics, including the effect of the **Peak** control (only the **Peak** control is active). You may use this mode to pinpoint an interference source with the **Peak** control, then switch to the SSB & NOTCH mode to suppress that interference.



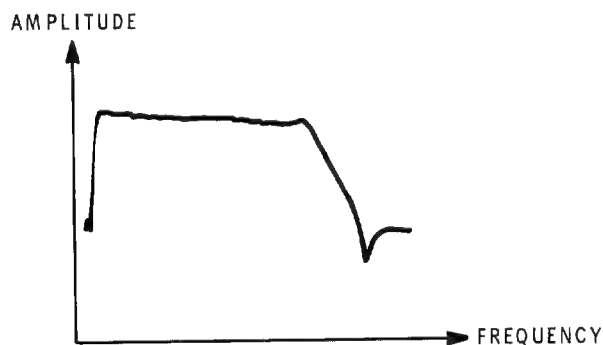
PICTORIAL 4-4

Pictorial 4-5 shows the **SSB & NOTCH** mode (pushbutton S2 pressed) Filter characteristics, including the effect of the **Low**, **Notch**, and **High** controls. If you switch to this mode from the **SSB & PEAK** mode, you may fine tune the **Notch** control to help reduce the interference source.



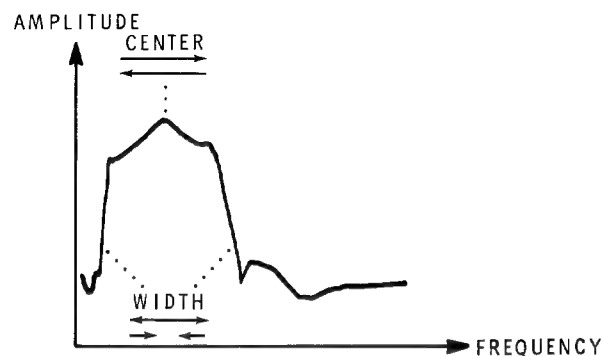
PICTORIAL 4-5

Pictorial 4-6 shows the **FIXED** mode (**SSB** and **SSB & Peak** pushbuttons pressed) Filter characteristics. The controls do not act since this is a fixed filter.



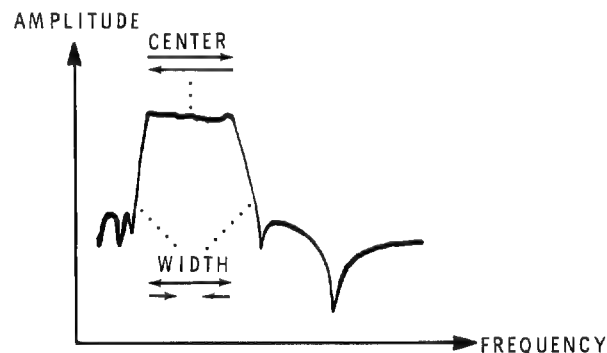
PICTORIAL 4-6

Pictorial 4-7 shows the **CW** mode (pushbutton S3 pressed) Filter characteristics, including the effect of the **WIDTH** and **CENTER** controls.



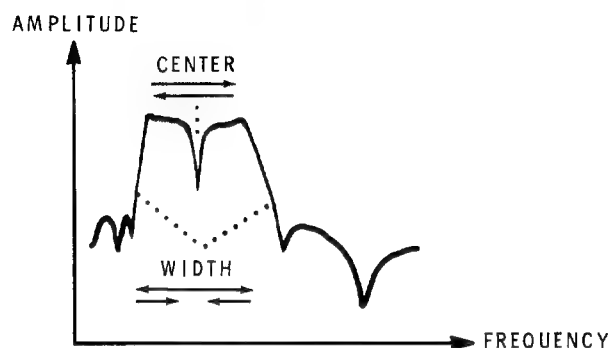
PICTORIAL 4-7

Pictorial 4-8 shows the **CW2** mode (pushbuttons S3 and S4 pushed) Filter characteristics, including the effect of the **CENTER** and **WIDTH** controls. Note that the bandpass is more flat across the top than it is in the **CW** mode.



PICTORIAL 4-8

Pictorial 4-9 shows the *RTTY* mode (SSB & Notch and *CW* pushbuttons pushed) Filter characteristics. The *WIDTH* control works as it normally does, but note that the *CENTER* control moves the entire bandpass up and down, with the notch in the center, while the *WIDTH* control changes the bandpass width.



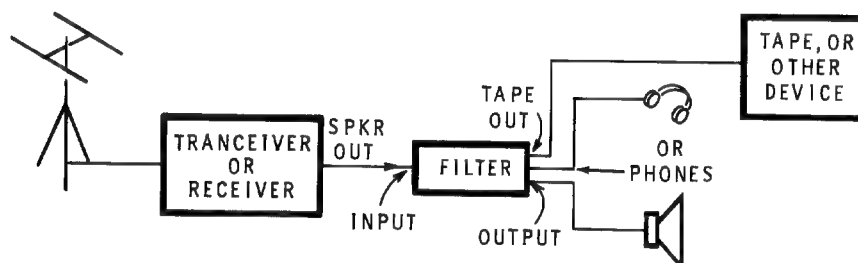
PICTORIAL 4-9

Typical Use in Your System

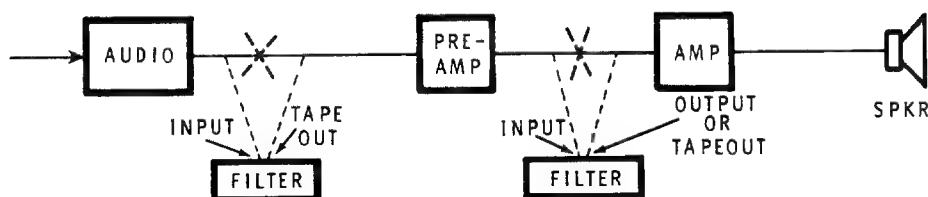
A typical system application is shown in Pictorial 4-10, with the Filter at your receiver or transceiver's speaker output. This position allows you to adjust volume from either the transceiver or Filter gain control (although 3 volts peak-to-peak from the transceiver will cause the INPUT OVERLOAD warning to light).

Pictorial 4-11 illustrates other possibilities you can employ with the Filter. If your system has the proper provisions, you may choose to put the Filter in line ahead of the amplifier or pre-amp. The Filter has a 5 k ohm input impedance and unity gain.

If you have a phone patch connected between your transceiver and speaker, you can install the Filter on either side of the phone patch. To process the audio before it is coupled to the telephone line, insert the Filter between the transceiver and phone patch.



PICTORIAL 4-10



PICTORIAL 4-11

IN CASE OF DIFFICULTY

This part of the Manual will help you locate and correct any difficulty that might occur in your Filter. This information is divided into two sections. The first section, "General," contains suggestions for reviewing your kit to locate possible causes of incorrect performance.

The second section is a "Troubleshooting Chart." This chart calls out specific problems that may occur and lists one or more conditions or components that could cause each difficulty.

NOTE: In an extreme case where you are unable to resolve a difficulty, refer to "Customer Service" information inside the rear cover of the Manual. Your Warranty is located inside the front cover.

GENERAL

1. Recheck the wiring. Trace each lead in colored pencil on the Pictorial as you check it. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something you consistently overlook.
2. Check for bits of solder, wire ends, or other foreign matter which may be lodged in the wiring.
3. About 90% of the kits that are returned for repair do not function properly due to poor connections and soldering. Therefore, you can often eliminate many troubles by reheating all connections to make sure they are soldered properly, as described in the soldering instructions in the Manual.
4. Check each circuit board foil to be sure there are no solder bridges between adjacent connections. Remove any solder bridges by holding a clean soldering iron tip between the two points that are bridged until the excess solder flows **down** onto the tip of the soldering iron.
5. Be sure each transistor and each integrated circuit is in the proper location (correct part number or type number). Be sure that each transistor lead is in the right hole and has a good solder connection to the foil. Check integrated circuits for proper positioning and for good contact at each pin connection.
6. Check capacitor values carefully. Be sure the proper part is wired into the circuit at each capacitor location. For example, it would be easy to mistake a .001 μ F capacitor for a 100 pF capacitor. Check each electrolytic capacitor to be sure the lead near the positive (+) marking is at the correct position.
7. Check each resistor value carefully. It would be easy, for example, to install a 2200 Ω (red-red-red) resistor where a 220 Ω (red-red-brown) resistor is called for. A resistor that is discolored, or cracked, or shows any sign of bulging would indicate that it is faulty and should be replaced.
8. Be sure the correct diode is installed at each diode location, and that the banded end is positioned correctly.
9. Check all component leads connected to the circuit boards. Make sure the leads do not extend through the circuit board and come in contact with other connections or parts, such as the chassis.
10. Check all the wires that are connected to the circuit board plugs. Make sure the wires do not touch the chassis or other lugs. Make sure all wires are properly soldered.

11. When a double-sided circuit board is used (there is a foil pattern on each side), the foil may pass through a hole in the board to carry the circuit from one side of the board to the other. Use an ohmmeter to check continuity of the foil through each hole.
12. If you still cannot locate the trouble and a voltmeter is available, check the voltage readings against those shown on the Schematic Diagram. A review of the "Circuit Description" may help you locate the trouble.

NOTE: To remove faulty multi-lead components from a circuit board, clip all the leads, and then unsolder and remove them one at a time.

NOTE: Refer to the "Circuit Board X-Ray View" on Page 12 of the Illustration Booklet for the physical location of parts.

Troubleshooting

This Troubleshooting Chart lists specific problems that could occur in your Filter and some possible causes. The numbers for the components are the same numbers used in the schematic diagram and circuit description. A circuit board X-ray view is provided (Illustration Booklet, Page 12) to help you locate any circuit board component. If a component is indicated, (such as S1, for example) check that part and any other components connected directly with it to see that they are installed correctly. Also check, if possible, to see that the component is working properly.

PROBLEM	POSSIBLE CAUSE
Output with power off is not the same as input.	<ol style="list-style-type: none"> 1. Jacks J1, J3, J4, J5 and associated wiring. 2. Power switch S1 and wiring.
No power; sound okay in power off position.	<ol style="list-style-type: none"> 1. Power source. 2. Power switch S1. 3. Power jack J2. 4. Diodes D1, D2, D3, D4, and D5. 5. Transistor Q1.
Power LED lights, but no sound.	<ol style="list-style-type: none"> 1. Low control set too high and High control set too low. Gain control not turned up. 2. Transistor Q1. 3. IC U8. 4. IC U13. 5. IC's U14, U15, U18, and U19.
Notch or Peak control does not work.	<ol style="list-style-type: none"> 1. Incorrect pushbuttons pressed. 2. Notch/Peak control not properly set. 3. IC's U2, U3, U18, U19, U20.
High filter does not work.	<ol style="list-style-type: none"> 1. SSB & Peak button must not be in. 2. High control not properly set. 3. IC's U4, U5, U6, U7, U18, U19, U20, and U21.
Low filter does not work.	<ol style="list-style-type: none"> 1. SSB & Peak button must not be in. 2. Low control not properly set. 3. IC's U8, U9, U10, U11, U18, U19, U21, and U22.
Filter works. Power LED does not.	<ol style="list-style-type: none"> 1. LED D8 (and wiring) polarity. 2. R4.
Filter works. Input overload LED does not.	<ol style="list-style-type: none"> 1. Input signal below overload point (2.5 to 3 volts p-p). 2. LED D9 (and wiring) polarity. 3. IC U1.

SPECIFICATIONS

High-pass Filter	5 pole tunable.
Range	300 Hz to 2500 Hz at - 6 dB.
Low-pass Filter	5 pole tunable.
Range	300 Hz to 2500 Hz at - 6 dB.
Notch/Peak Filter	2 pole tunable.
Range	300 Hz to 2500 Hz.
Width	200 Hz at 6 dB.
Depth	30 dB.
Input Impedance	5 k Ω minimum.
Nominal Gain	Unity.
Audio Amplifier Power	1 watt into 4 Ω .
Input/Output Connections	One 1/4" phone jack ("Phones"). Three RCA type phono jacks ("Input," "Output," and "Tape Out"). One power connector.
Controls	
"Low, Center"	Tune high-pass filter, or move bandpass center.
"Notch/Peak"	Tune notch/peak filter.
"High, Width"	Tune low-pass filter, or adjust band-pass width.
"Gain"	Adjust audio gain.
Switches	
"Power"	Controls power and filter bypass.
"SSB & Notch"	Selects optimized SSB filtering, with an adjustable notch.
"CW"	Selects optimized CW filtering.
"SSB"	Selects optimized SSB filtering.
"SSB & Peak"	Selects optimized SSB filtering, with an adjustable peak.
"RTTY"	Selects optimized RTTY filtering.
"CW2"	Selects CW filtering, similar to "CW" with flatter bandpass.
"Fixed"	Selects 300 Hz to 2500 Hz bandpass and disables variable controls.

Power Requirements	7 to 13.5 VAC, or 9 to 18 VDC, 400 mA. Heath's PS-5012 (for 120 VAC) or PS-5024 (for 240 VAC) is recommended.
Dimensions	1-7/8" H × 8-7/8" W × 6-5/8" D. (4.5 × 22.5 × 17 cm)
Weight	1.5 lbs.(0.7kg).

Heath Company reserves the right to discontinue products and to change specifications at any time without incurring any obligations to incorporate new features in products previously sold.

CIRCUIT DESCRIPTION

You may use this Circuit Description if you wish to learn more about the operation of the Filter, or as an aid in troubleshooting your circuit. Refer to the fold-in Schematic diagram as you read.

The Filter consists of two five-pole elliptical filters (a high pass and a low-pass), plus a two pole notch (or peak) filter.

CONTROL OSCILLATOR CIRCUIT

The oscillator is the source of the 22 kHz triangular wave that the Filter uses to control the action of the high, low, and notch/peak filters. Block Schematic 1 shows the phase shift oscillator using U14 and U18D. Resistor R104 and capacitor C55 shape the voltage waveform at pin 11 of U18D into the desired triangular wave. This wave goes to comparators U18A, B, and C. U18D provides feedback to U14 to keep the oscillator running.

HIGH FILTER AND LOW FILTER

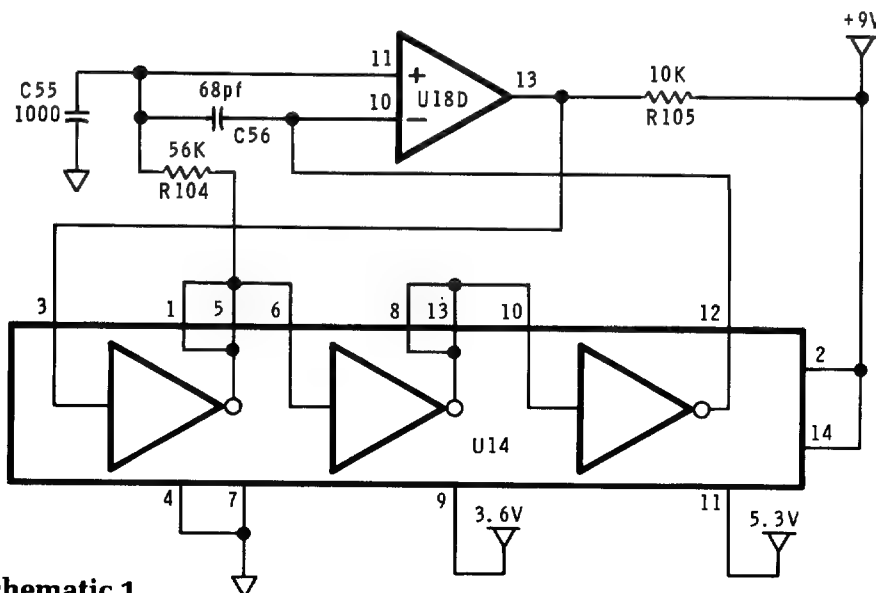
The filters are five pole filters with a variable cutoff frequency. The high filter consists of U4B, U5A & B, U6A & B, U7A & B, and U8B, plus FET switches U21B, C, and D, and U20C and D. The low filter consists of U9A & B, U10A & B, U11A & B, and U12A & B, plus FET switches U21A, U22A, B, C, and D. Consider the FET switches to be variable resistors, to make this discussion easier.

Refer to the waveforms shown in Pictorial 5-1 (Illustration Booklet, Page 11) as you read about the filter operation. Since the high and low filters operate essentially the same, only the high filter will be discussed here. You may use the same principles to understand how the low filter works.

The filters are controlled through the comparators. U18A is the high filter control. The inputs to the comparator are shown in the Comparator Input section of Pictorial 5-1. The first input, to pin 5, is the 22 kHz triangular wave from the control oscillator. The second input is a DC control voltage that is set by R89, the High control. Three different settings of the DC voltage are shown in the Comparator Input section of Pictorial 5-1, and are labeled "A," "B," and "C." Both the triangular and the DC control voltages vary between 3.6 and 5.2 VDC.

The comparator output that results from DC control voltages "A," "B," and "C" is also shown in Pictorial 5-1. Note from the Pictorial how the duration ("on time") of the output increases as the DC control voltage decreases.

This comparator output pulse is routed through two inverter-buffers, U19A and U19B, to the FET switches. These "switches" act as variable resistors in the filter circuit, providing lower resistance as the "on time" increases. Higher resistance moves the filter cutoff point lower in frequency.



Block Schematic 1

To sum up the control action, assume High control R89 is adjusted to increase the DC control voltage at comparator U18A.. This produces a shorter duration "on time" at the comparator's output. The output goes through the two inverters, ending up not inverted. This short "on time" causes the FETs to act as higher resistances and thus moves the filter's cutoff point lower in frequency.

NOTCH/PEAK FILTER

The notch/peak filter is a two-pole filter composed of U2A & B, U3A & B, and FET switches U20A & B. The circuitry responds (and is controlled) essentially in the same way as the high and low filters.

CONTROL VOLTAGES

U15A and B provide the fixed voltages needed by the High, Low, and Notch/Peak controls (R89, R91, and R92). The voltages from the resistors' wipers then go to the switches. The switch settings determine which voltages go to the control oscillator's U18 comparators and finally end up controlling the filters.

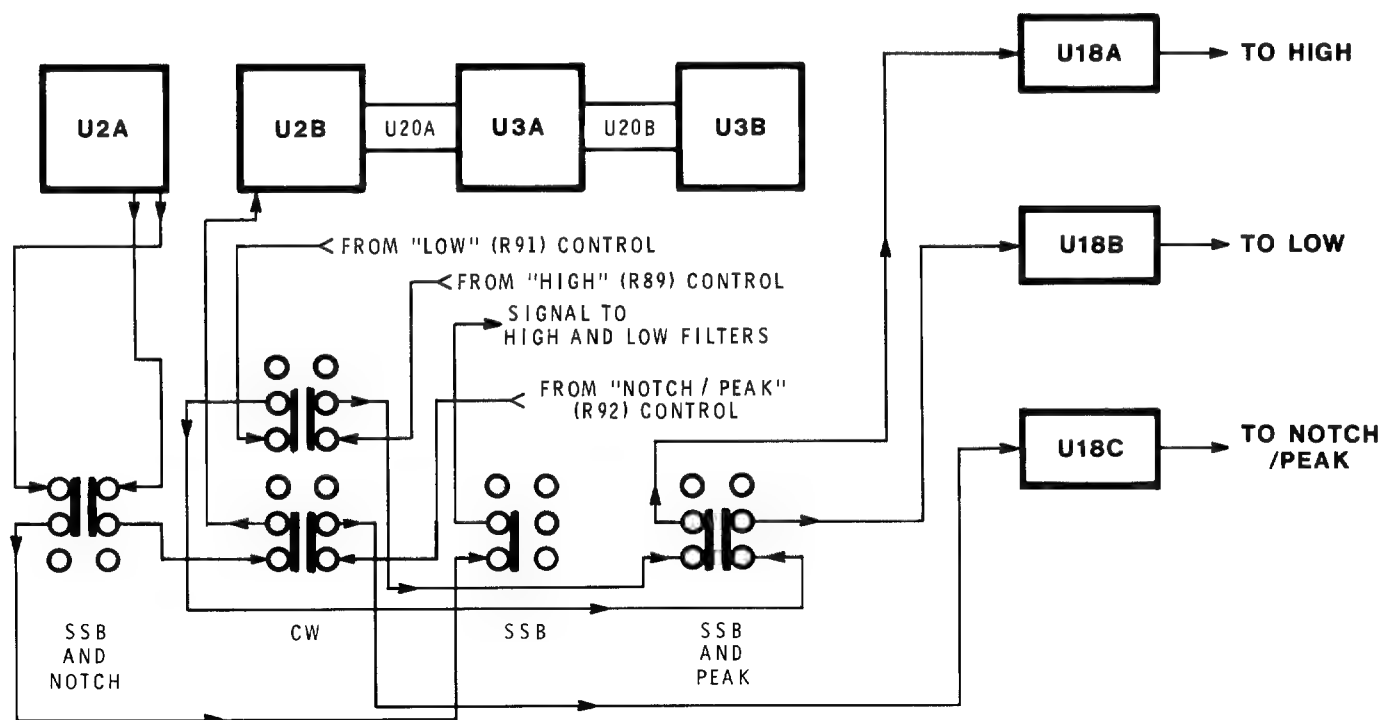
PUSHBUTTON SWITCHING

It is possible to understand what happens when you press a pushbutton if you study the schematic, but this can be a rather time-consuming task, requiring careful attention. To make this understanding more easy to come by, the following blocks and discussions handle each pushbutton separately.

SSB And Notch Pushbutton Switch

Refer to Block Schematic 2.

Note that the signal output from the notch filter (U2A) goes to both sides of the SSB/Notch switch. The signal to the left side of the switch goes through the SSB switch and becomes the input to the high and low filter circuitry. The signal to the right side of the SSB/Notch switch is fed to the notch filter (again, through the CW switch) to support the notch filter action. R92 positions the notch, through another contact set of the CW switch, by varying the voltage at U18C.

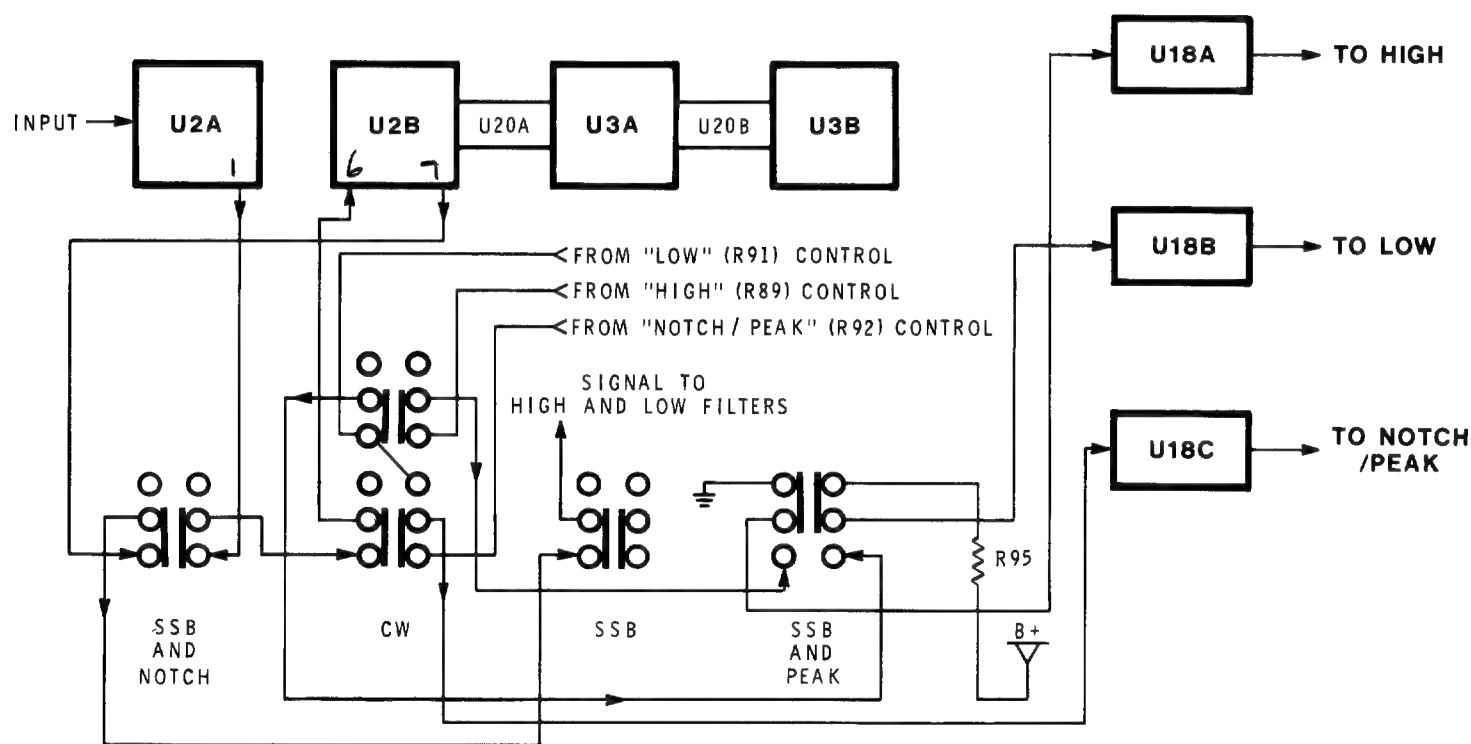


Block Schematic 2

SSB And Peak Pushbutton Switch

Refer to Block Schematic 3.

When you compare this configuration to Block 2, you will note that the signal to the high and low filters (through switch SSB) comes from the output of U2B for this (peak) operation, whereas it came from U2A for notch operation. As before, the voltage from the Peak control (R92) is processed through switch CW. Note, however, that the High and Low controls are disconnected at the SSB/Peak switch. Instead, SSB/Peak connects U18A to ground, and U18B to B+ to fix the positions of the high and low filters.



Block Schematic 3

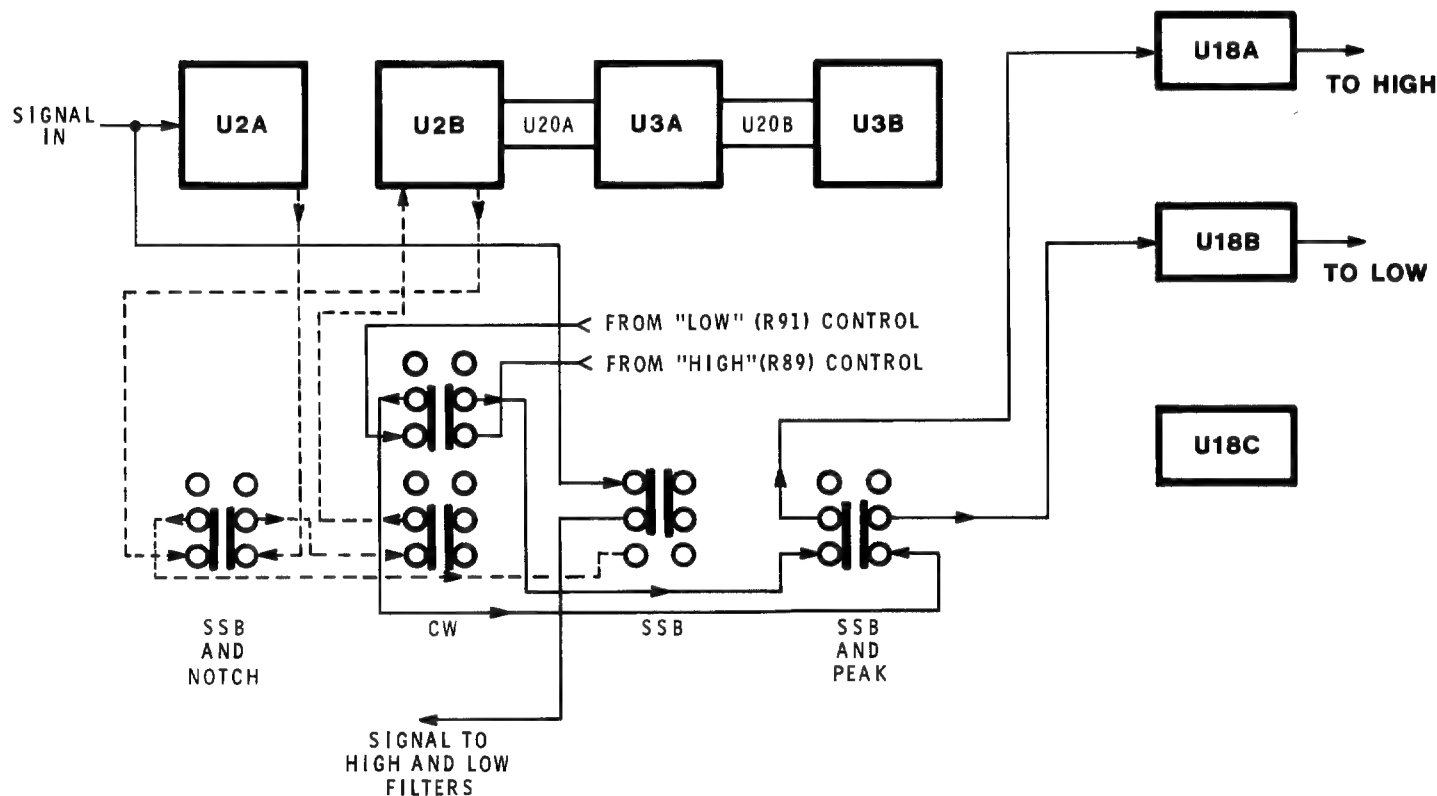
SSB Pushbutton Switch

Refer to Block Schematic 4.

Note first that the normal output from the notch filter reaches a dead-end at the SSB switch. Instead the "signal in" is taken from the U2A input, and fed through the SSB switch to the high and low filters (without any processing from the notch/peak). As before, the voltage from the High and Low controls (R91 and R89) are processed through the CW and SSB/Peak switches.

Filter Shift

U16A and B are active when the CW pushbutton is pressed (refer ahead to Block Schematic 5). They shift the voltages applied to U18A and U18B; this shifts the high and low filters. The Low control shifts both filters in the same direction, effectively moving the bandpass up or down. The High control shifts the two filters in opposite directions, to control the width of the bandpass.



Block Schematic 4

CW Pushbutton Switch

Refer to Block Schematic 5.

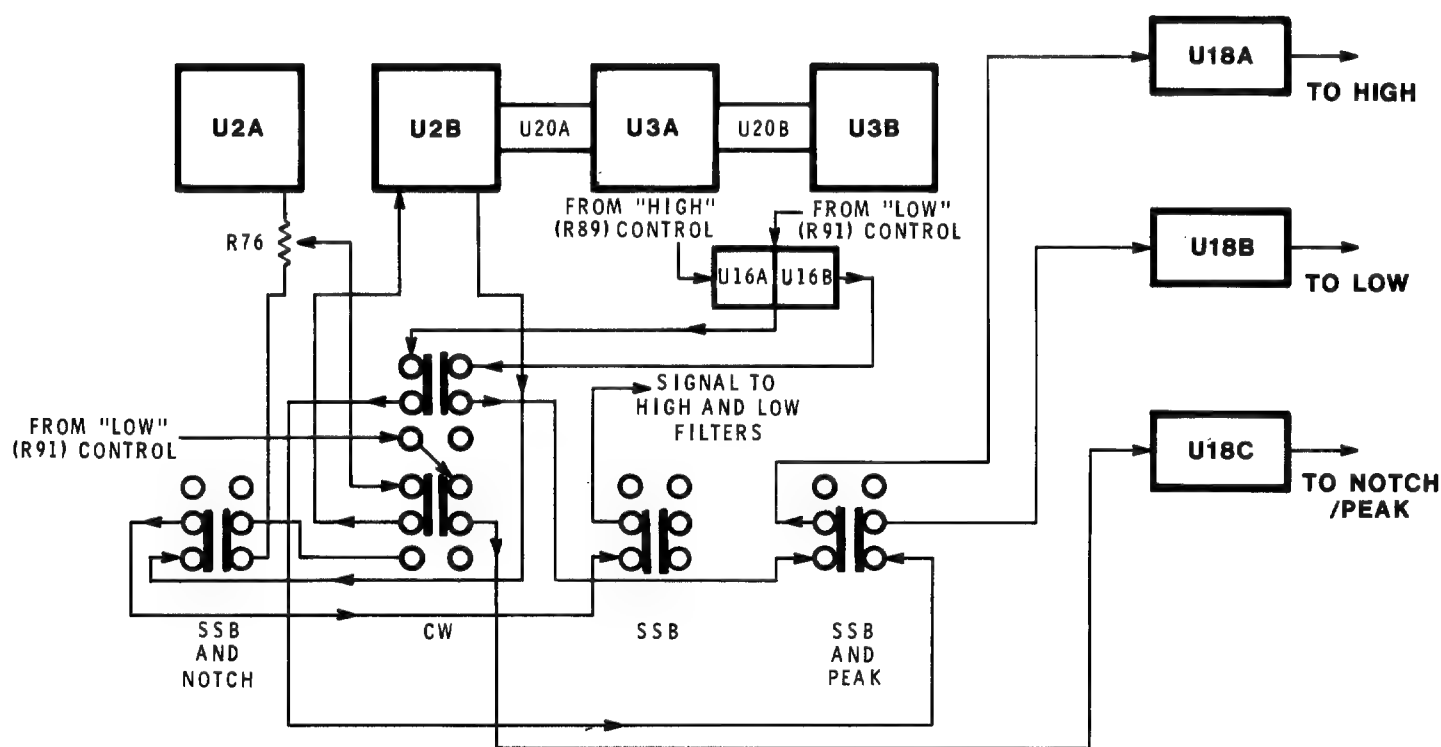
In this configuration, the CW switch uses the input from U16A and U16B (see "Filter Shift") to move the high and low filters. Low control R91 moves high and low filters in the **same** direction to effectively move the whole bandpass up or down. High control R89 moves the high and low filters in **opposite** directions to effectively set the width of the bandpass. The Notch/Peak control voltage reaches a dead-end at the CW switch. The small peak is controlled by the High control (R89).

SUPPLY VOLTAGE

The input voltage, whether it is AC or DC, is filtered and rectified as necessary by L1, L2, L3, D1, D2, D3, D4, and C5. This unregulated voltage goes through the Power switch to light power LED D8, and is supplied to the PA (audio amp) through R5 with C6 and C7, providing added filtering. Q1 regulates the power for the filter portion of the unit. U8A then acts as a voltage divider to provide the reference voltage for the filter.

INPUT OVERLOAD INDICATOR

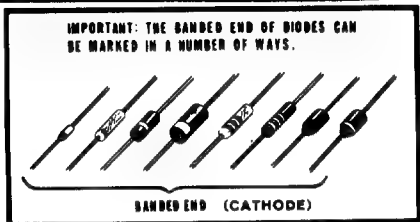
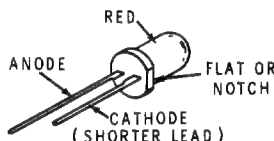
U1 compares the input voltage (pin 3) to the voltage on pin 2 (determined by voltage divider R8 and R9). If the input exceeds the pin 2 voltage, the output (pin 7) goes low, turning on LED D9.




Block Schematic 5

SEMICONDUCTOR IDENTIFICATION CHARTS

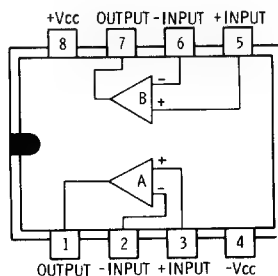
DIODES

COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
D6, D7	56-56	1N4149	
D5	56-608	1N4739A	
D1, D2, D3, D4	57-65	1N4002	
D8, D9	412-633	Light-emitting diode (LED)	

TRANSISTOR

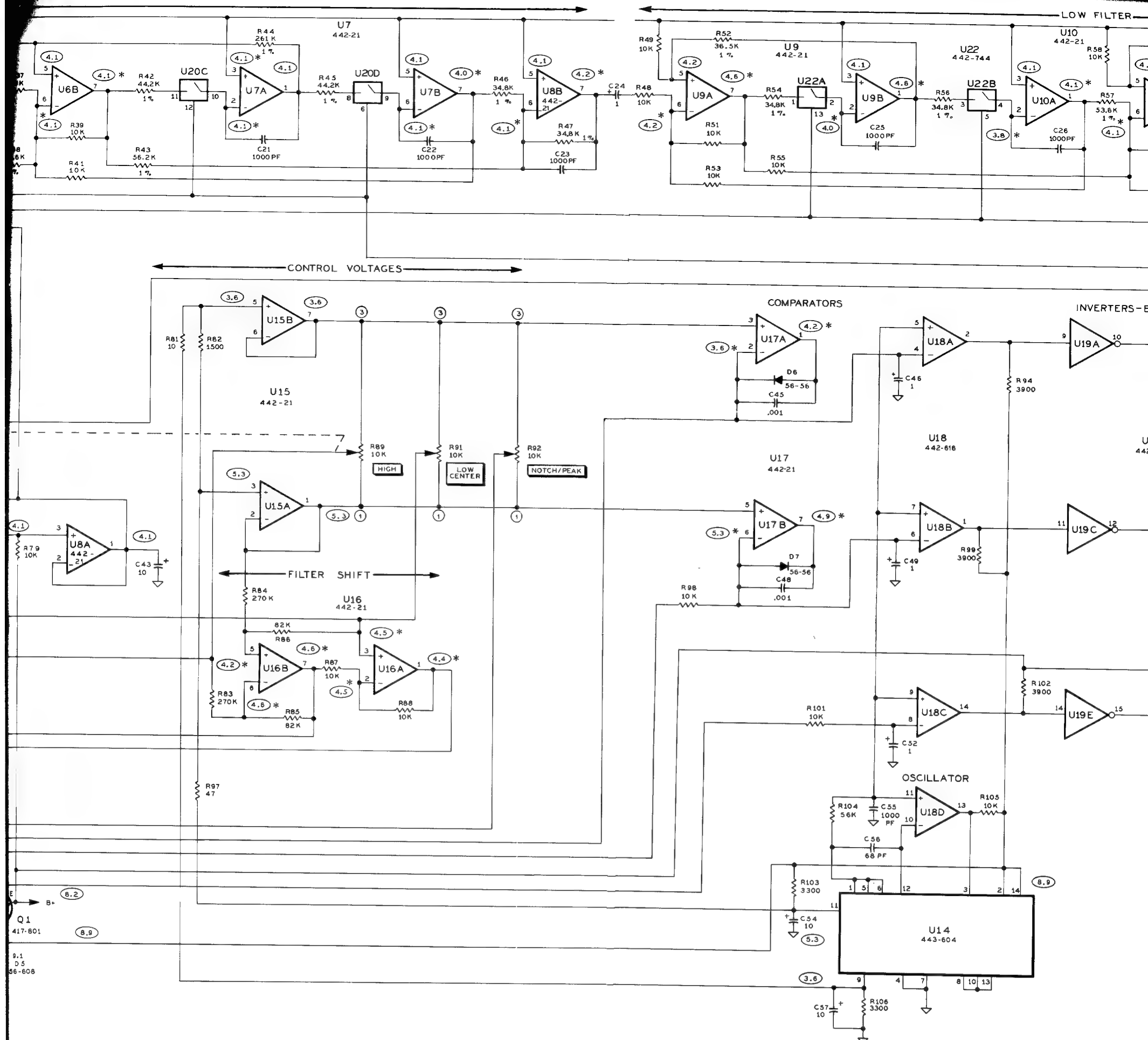
COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
Q1	417-801	MPSA20	

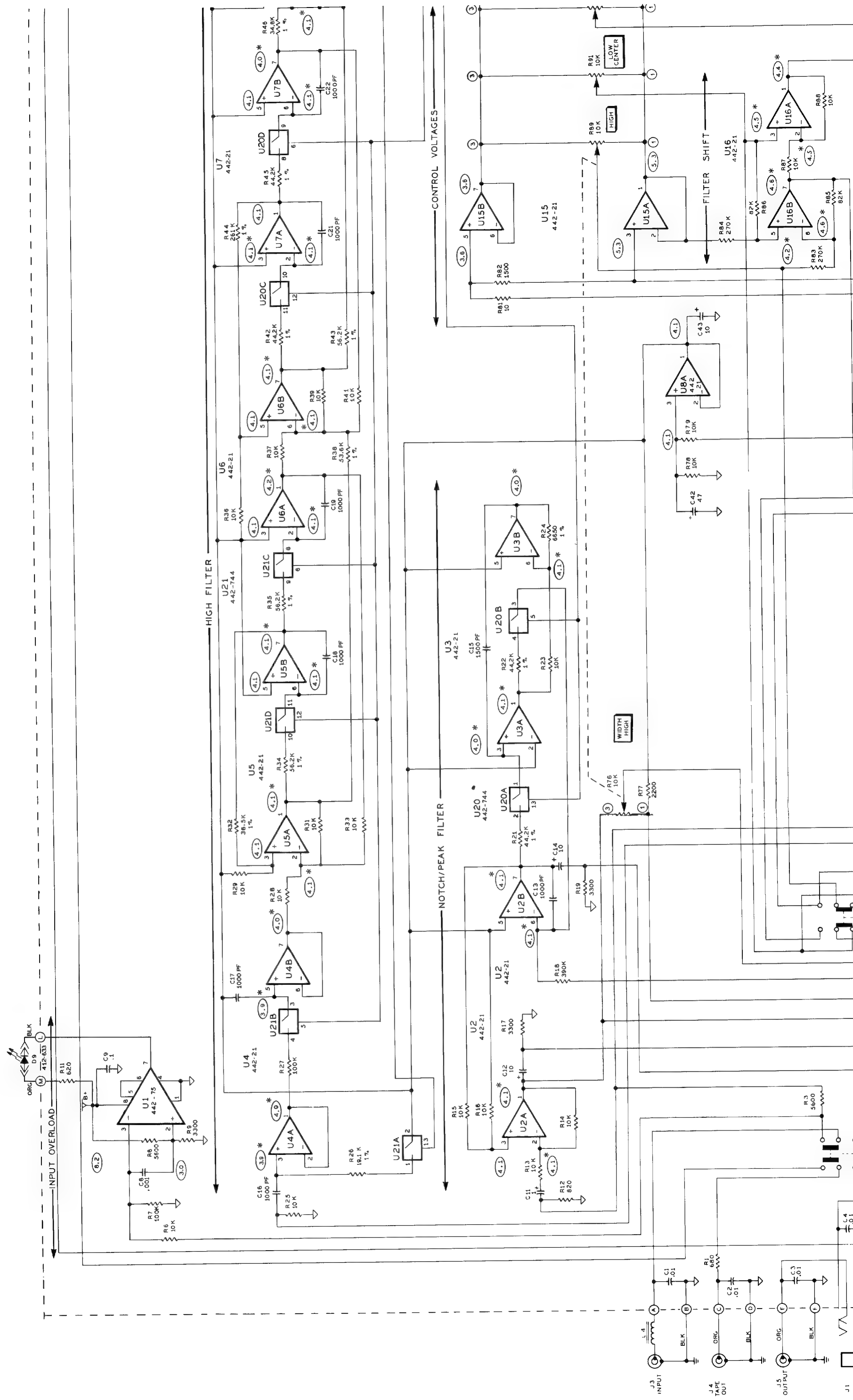
INTEGRATED CIRCUITS

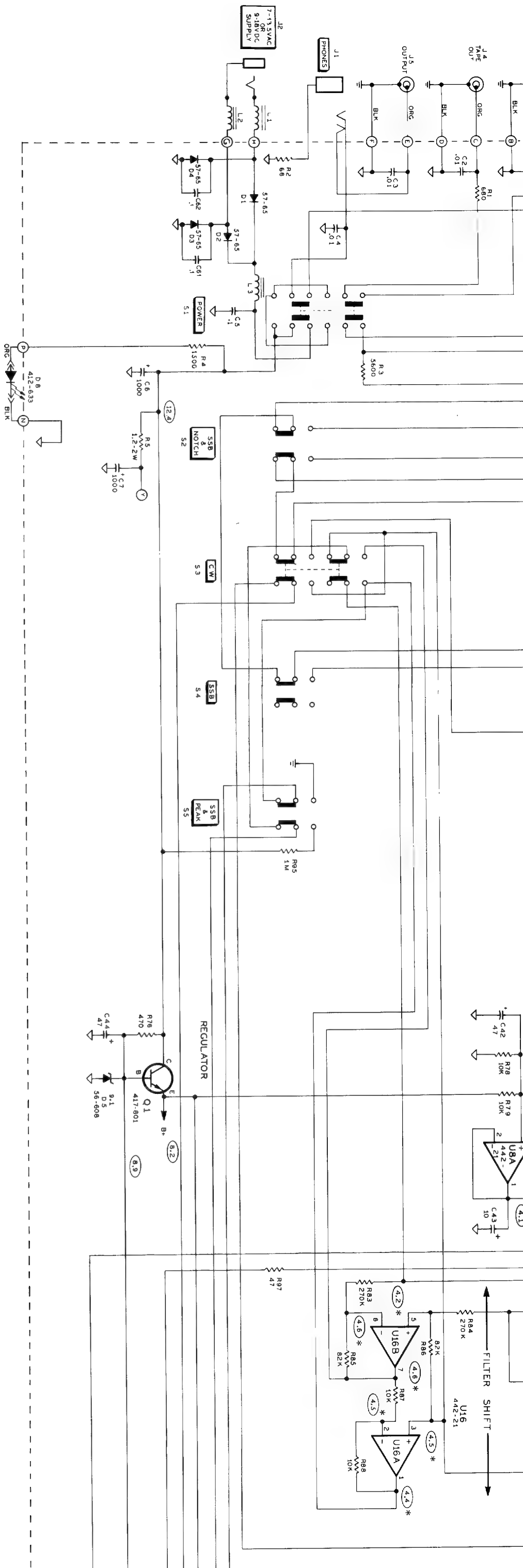
COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
U2 THROUGH U12, U15, U16, U17	442-21	MC1458	

COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
U1	442-75	LM311	
U18	442-616	LM2901	
U20, U21, U22	442-744	CD4066	

COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
U13	442-748	ULN2280B	
U14	443-604	CD4007AE	
U19	443-701	MC14049CP	







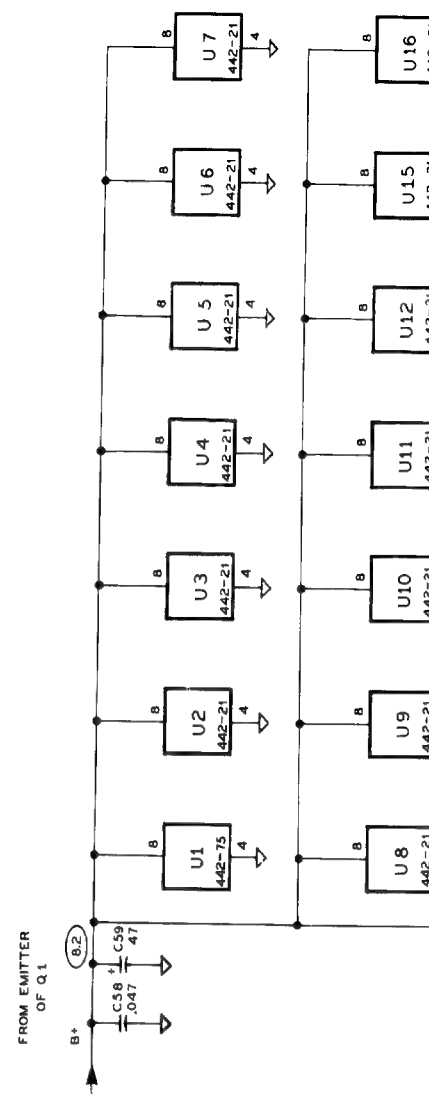
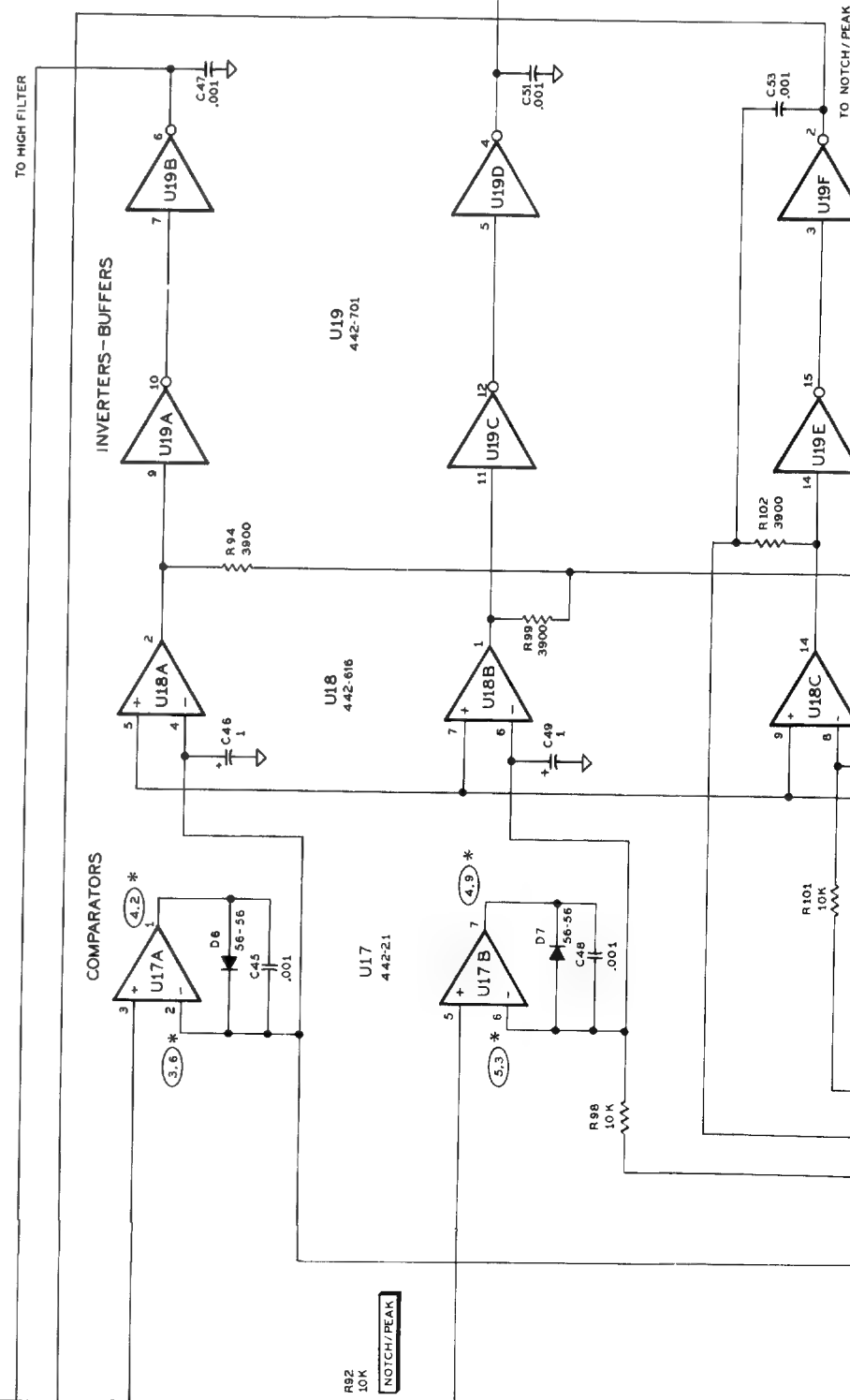
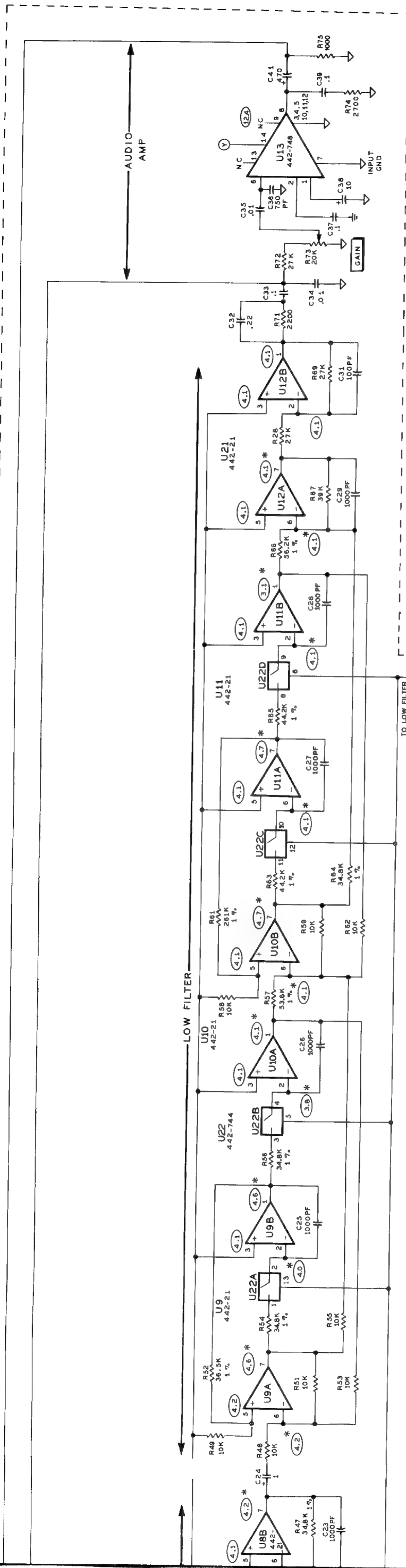
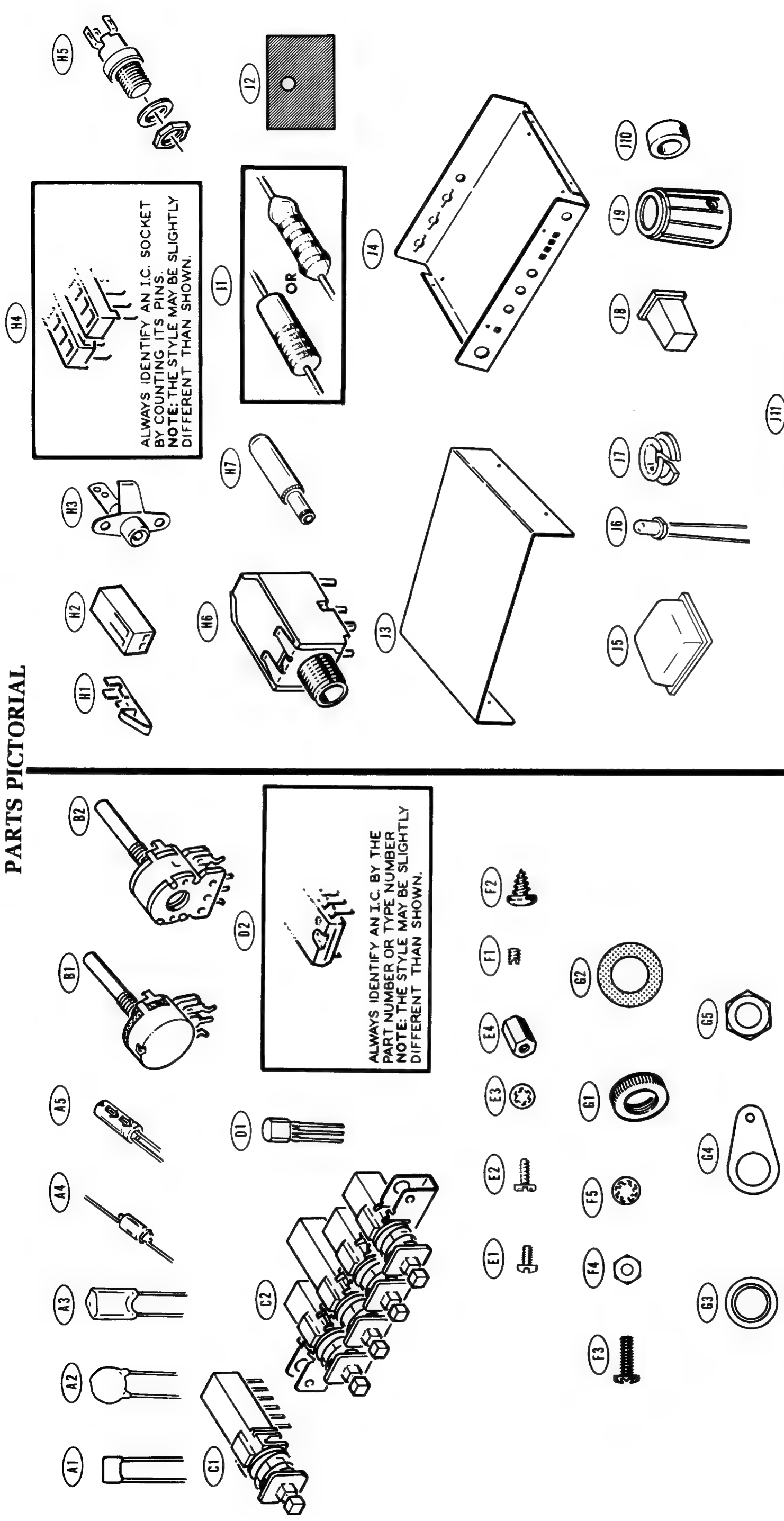
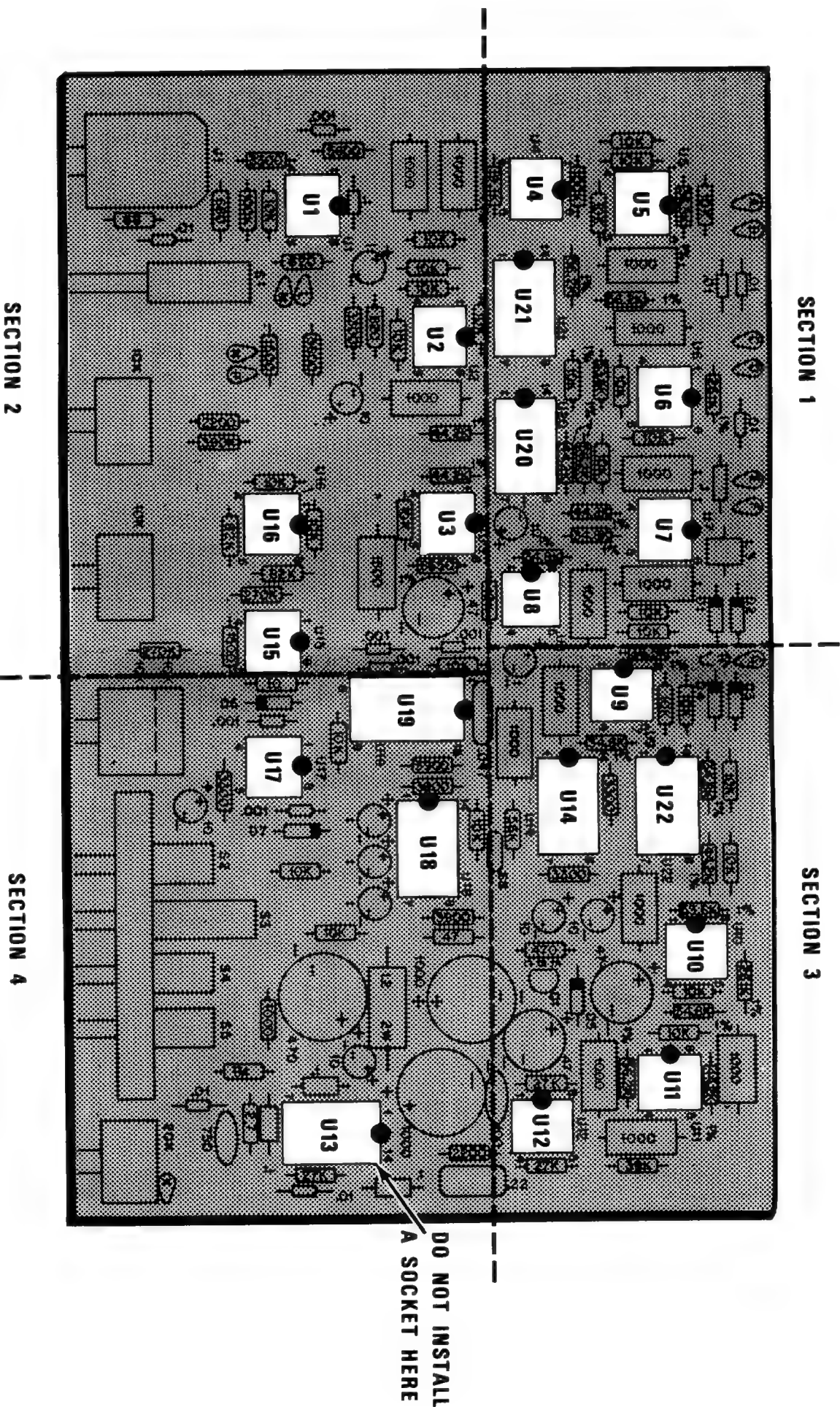


ILLUSTRATION BOOKLET

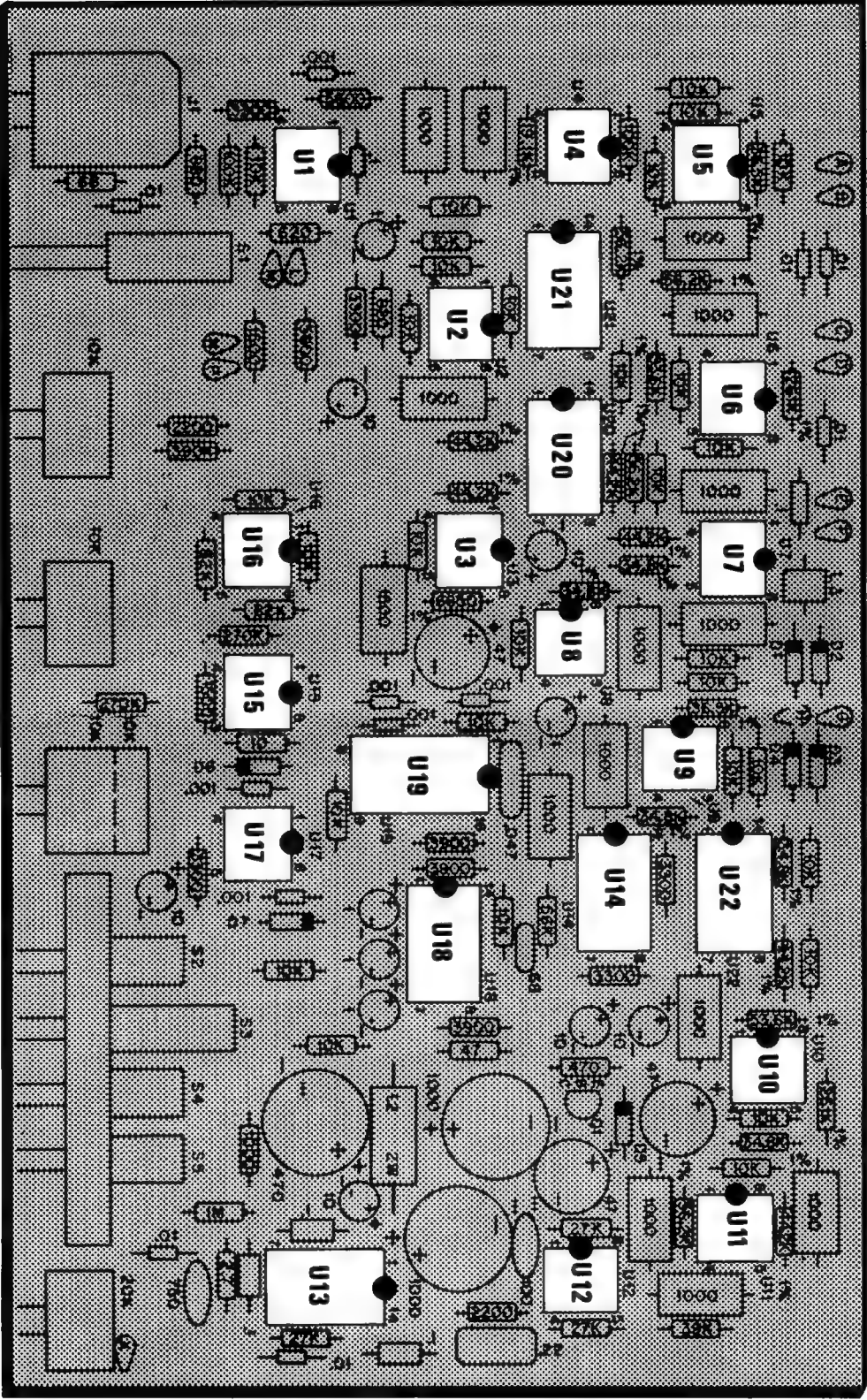
Part of 595-2980

PARTS PICTORIAL

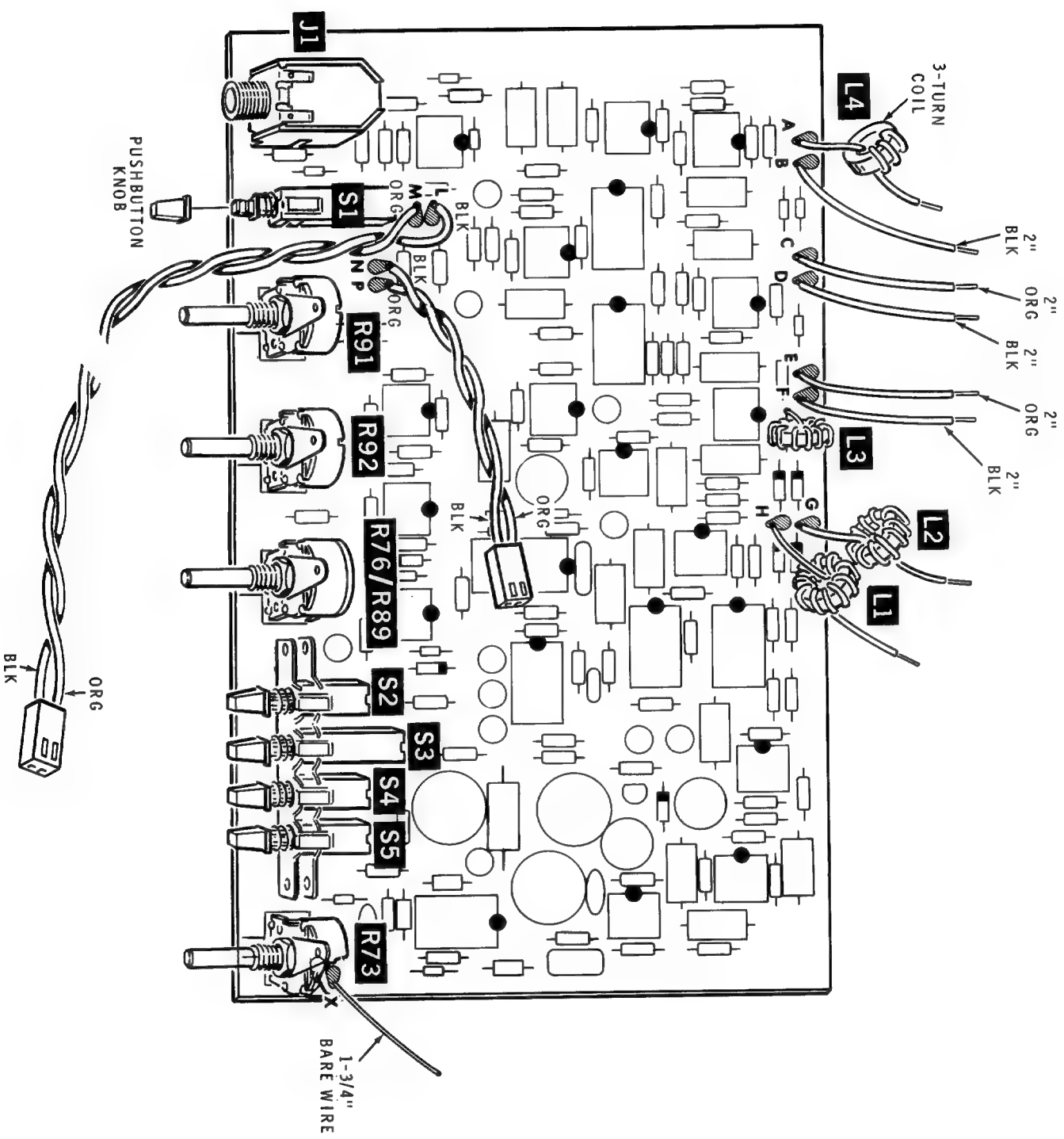




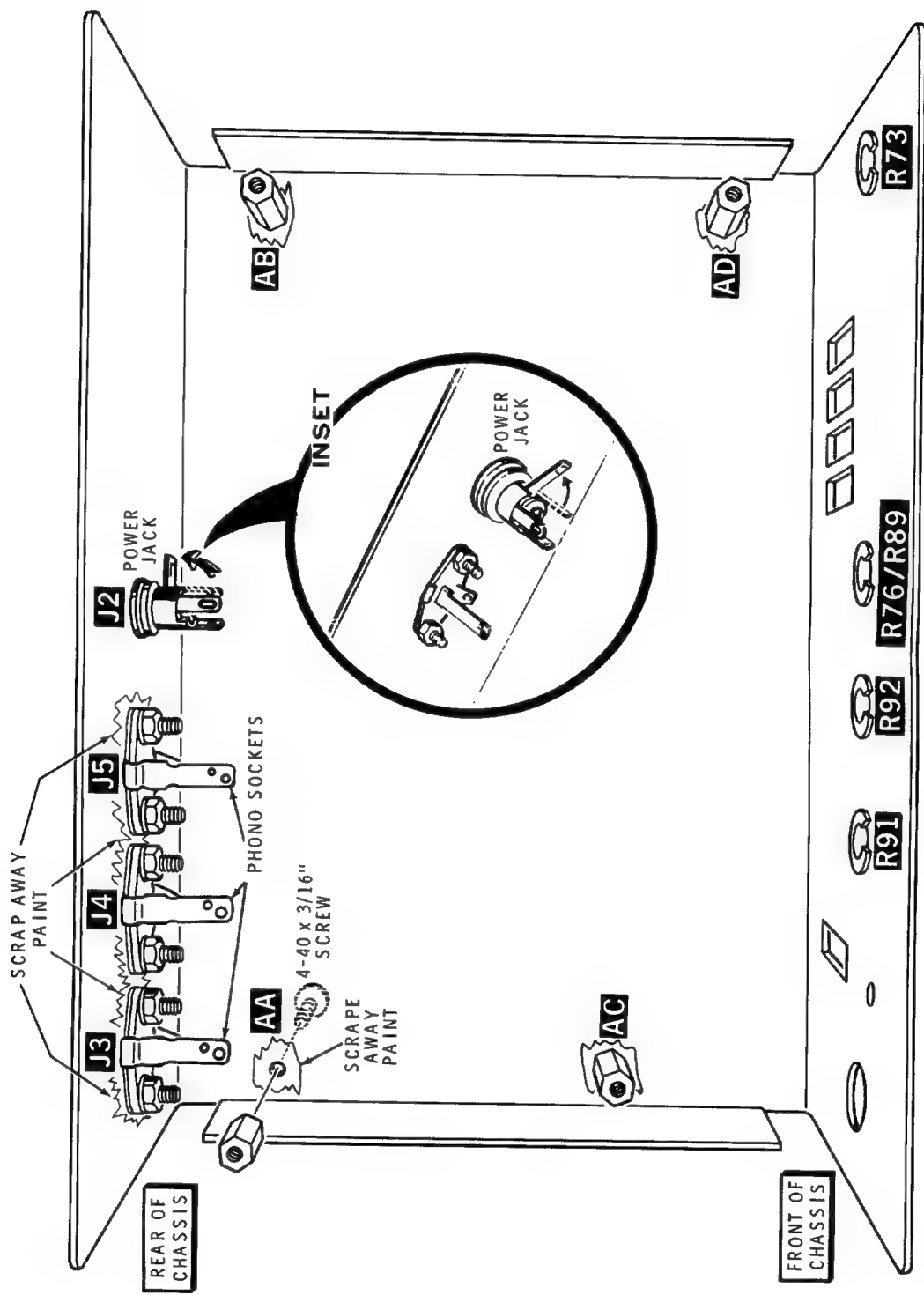
PICTORIAL 1-2



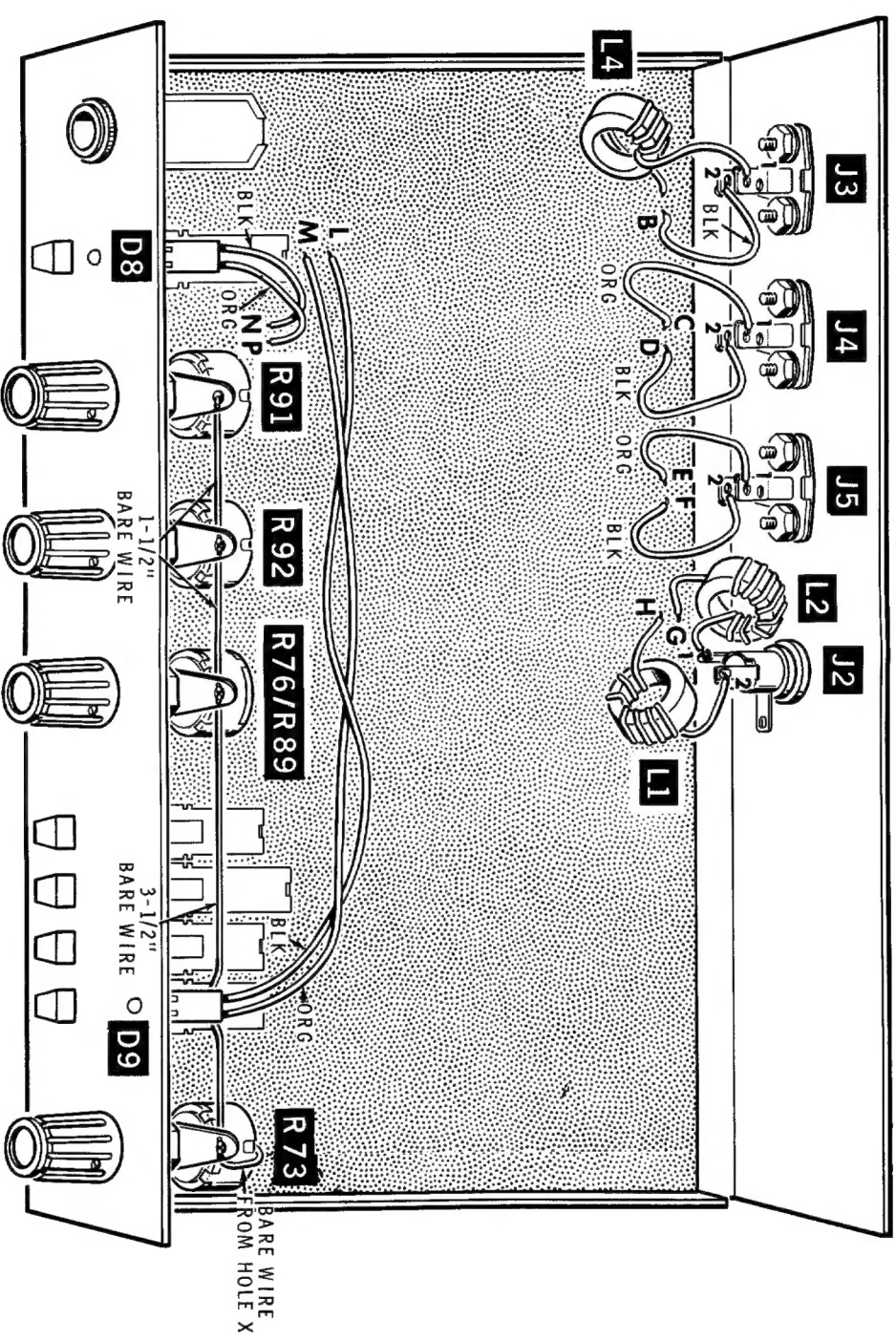
PICTORIAL 1-4



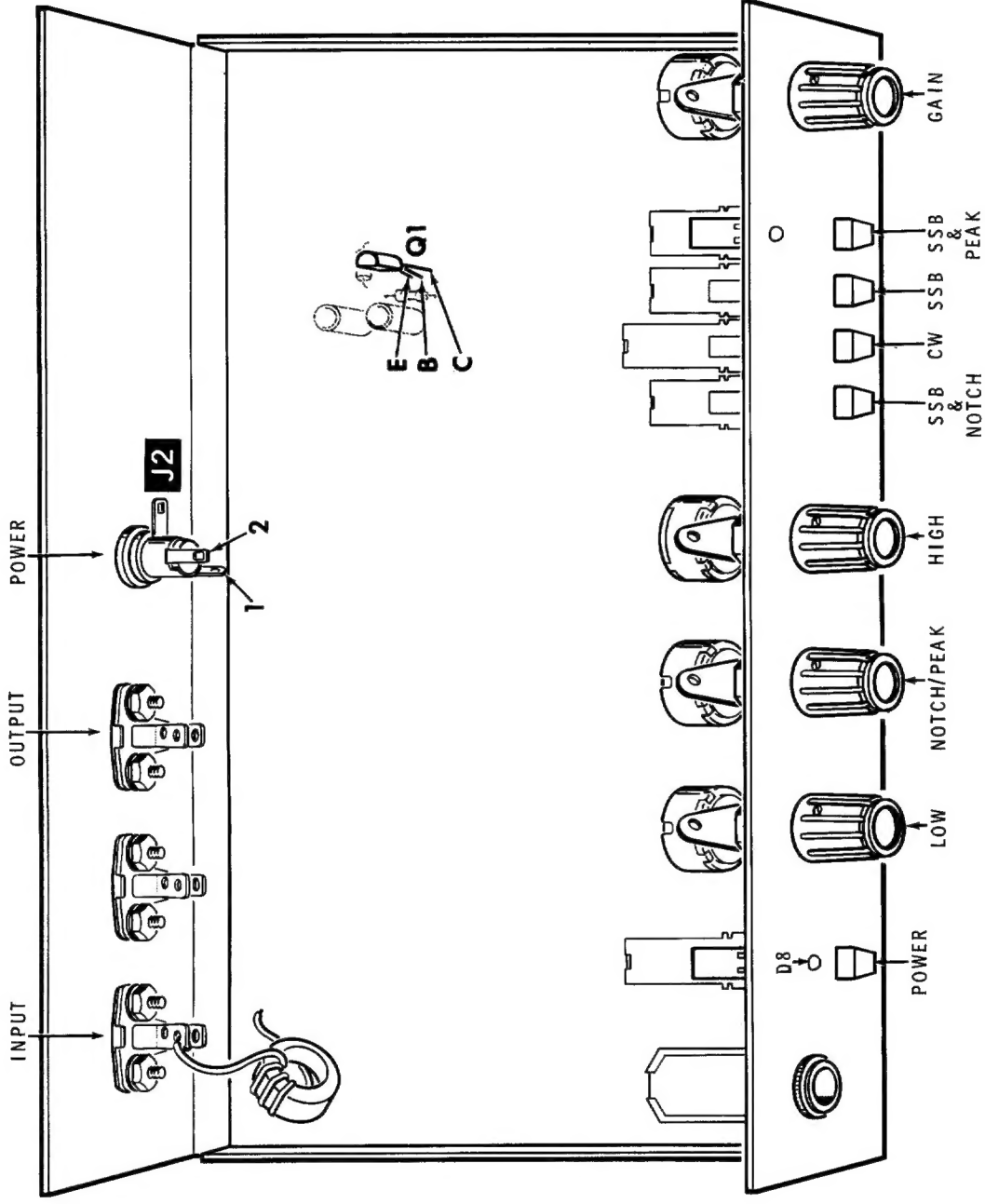
PICTORIAL 1-6



PICTORIAL 1-7



PICTORIAL 1-8



PICTORIAL 2-1

CIRCUIT BOARD X-RAY VIEW

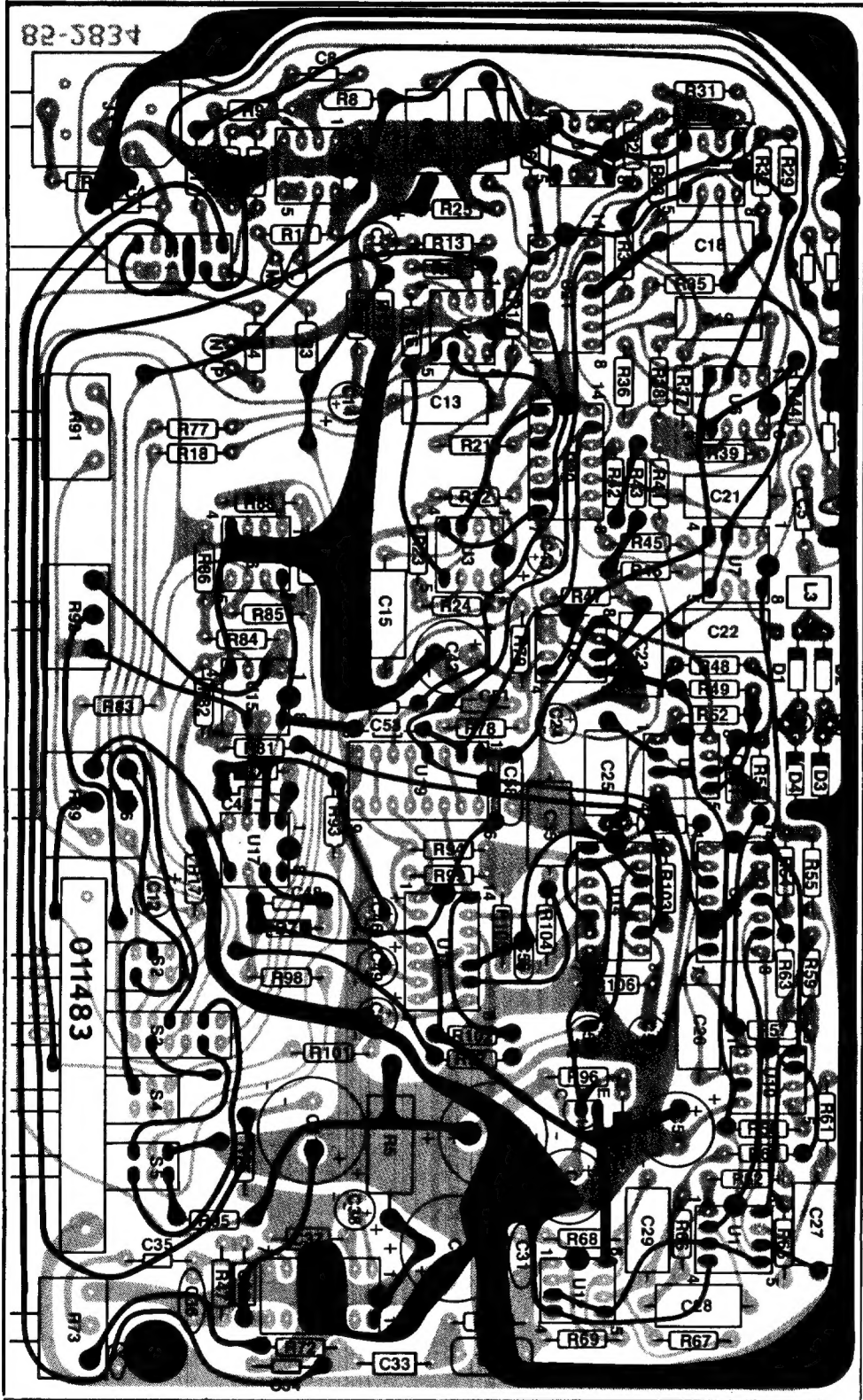
NOTE: To find the PART NUMBER of a component for the purpose of ordering a replacement part:

- A.

Find the circuit board number (R5, C3, etc.) on the X-Ray View.
- B.

Locate this same number in the "Circuit Component Number" column of the "Parts List."
- C.

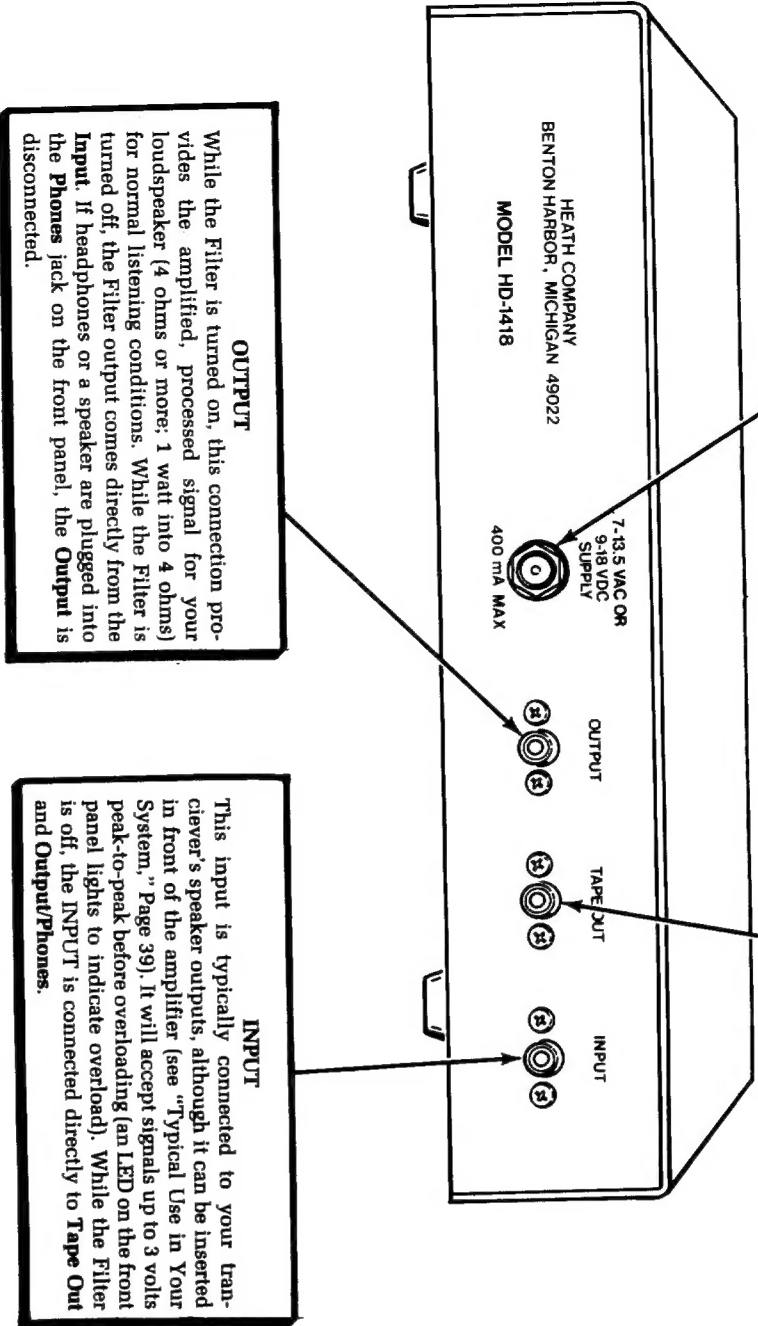
Adjacent to the circuit component number, you will find the PART NUMBER and DESCRIPTION which must be supplied when you order a replacement part.



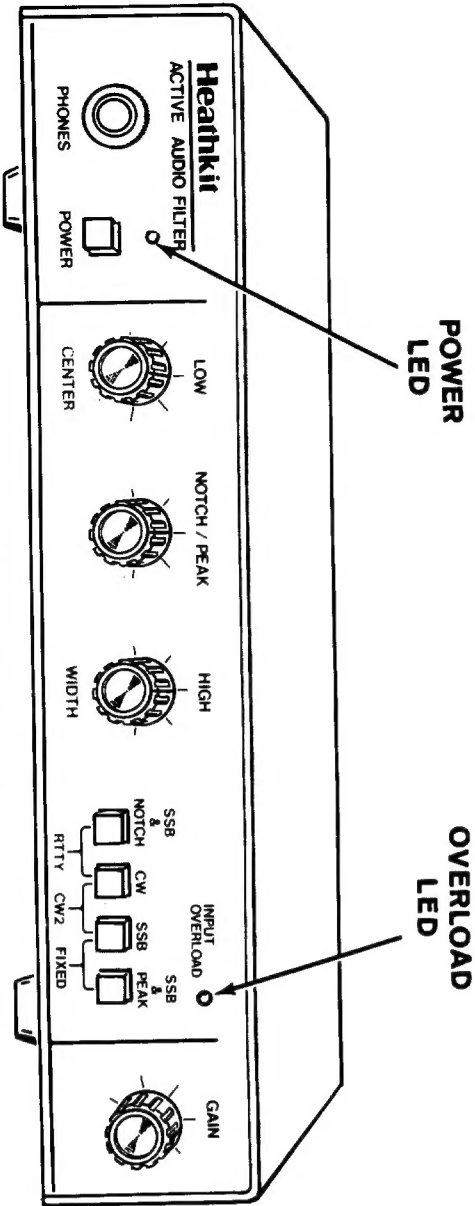
(Shown from the component side.
The foil on the component side is shown in red.)

7-13.5 VAC OR 9-18 VDC SUPPLY
 You can apply either an AC or DC power source (400 mA), such as the Heath PS-5012, for operating power. The filter has its own rectification, regulation, and filtering.

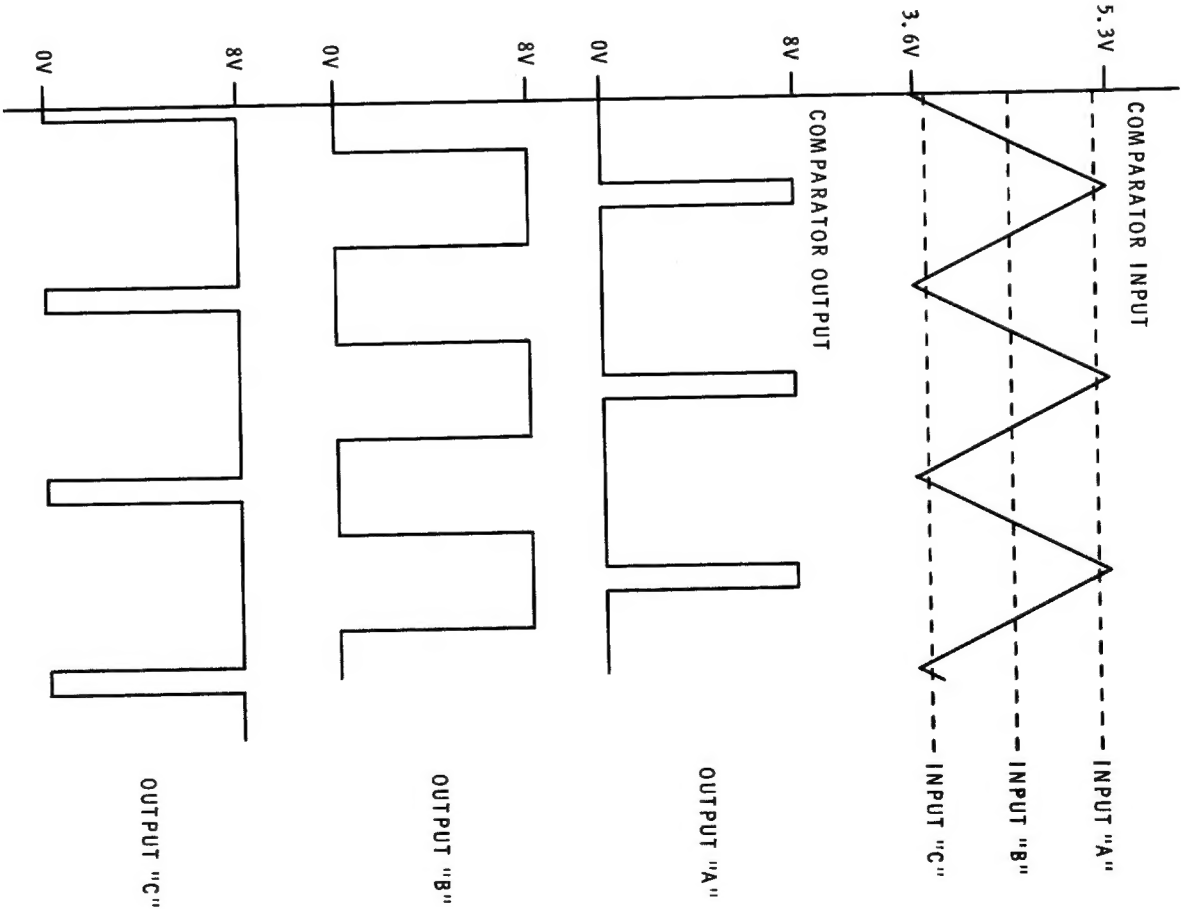
TAPE OUT
 While the Filter is turned on, the processed (but not amplified) signal is available at **Tape Out** for high impedance inputs. This signal is about 20 dB below the level of the input to the Filter. While the Filter is turned off, the signal at **Tape Out** is taken directly from the Filter **Input** connection.



PICTORIAL 4-1



PICTORIAL 4-2



PICTORIAL 5-1